AN ABSTRACT OF THE THESIS OF

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The researcher explored interpersonal trust (a construct from the fields of psychology and sociometry) in the context of engineering work groups. The study explored the potential antecedents of trust and the relationships among trust, creativity, communication, emotional empathy and positive affect. The study attempts to argue that 1) trust is deeply involved in the neurological development of humans from a very early age, 2) the level of trust is an important factor in the development of a person's emotional experience, 3) an individual's level of trust can improve with experience, 4) higher levels of trust can streamline task team performance, especially when creativity and communication are important, and 5) in industries that use task teams and that require innovation, high levels of interpersonal trust can be a source of competitive advantage.

Analysis of the literature of social and industrial psychology leads to the hypothesis that trust is positively and significantly correlated with creativity, communication, emotional empathy and positive affect. Sociometric survey research of engineers (n=43) employed at a medical device manufacturing company fails to show support for this hypothesis.

Trust, Communication and Creativity in New Product Development Teams

by

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Major Professor, representing Industrial Engineering

Chair of Department of Industrial and Manufacturing Engineering

Dean of Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Redacted for privacy

Thomas John Charles Siacotos, Author

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Thank you, everyone! -- TJS

Newark, California
March, 1998

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Dedication

For my best friend Carol,
and for the best friends we share,
Nicholas and Mark

Trust, Communication and Creativity in New Product Development Teams

Introduction

Innovation is a key competitive weapon in the development and marketing of "high-technology" products. Engineers work to develop new designs in ever decreasing time frames. Manufacturers rely on techniques to nurture the creativity and communication required for innovation. However, creativity can be elusive, especially in a team setting.

"Interpersonal difficulties" can slow or prevent innovation. Often, these problems come down to a question of interpersonal trust (or mistrust), yet leaders have few good alternatives to enhance interpersonal trust. If we can understand the relationships among trust, communication, creativity and innovation, we might understand or learn how to coach individual contributors for trusting attitudes and trust-building behaviors.

In the text that follows, we examine the sources of trust and explore whether a high level of trust in an organization can lead to more innovation and, possibly, to sustainable strategic advantage.

The medical device industry and new product development teams

INDUSTRY STRUCTURE DEMANDS RAPID INNOVATION

To survive, manufacturers of medical devices must innovate product designs and introduce them rapidly. The requirement to innovate arises because of industry structure. Several factors characterize the industry: rapid growth, customer openness to device iteration, moderate capital requirements, and innovation as defense against competition.

Physicians are the industry's primary customers. These include primarily surgeons from various specialties, if we focus our attention on the part of the medical device industry that makes "non-invasive products" (e.g., catheters, implantable defibrillators, and laparoscopes).

Because of devices like these, physicians now offer alternative procedures which are, for the most part, less invasive than traditional surgery. Physicians have their customers too -- patients, and patients are motivated to select less-invasive alternatives when they can. The advantages to the patient include less damage to surrounding tissue, less aggressive anesthesia,

reduced pain, faster recovery with fewer complications, less time in the hospital and less need for drugs during recovery. (In some cases, the alternative procedure improves safety, efficacy, requirements for later intervention and long-term prognosis as well).[1] Consequently, patient interest in these procedures is generally high, and ultimately drives demand for product, though not necessarily for innovation.

The health-care industry is undergoing tremendous change, creating strong economic pressure to reduce the overall health care bill for the nation. Insurers also gain economically from rapid advances in non-invasive techniques. For example, the bill for treatment of arteriosclerotic lesions in arteries feeding the heart muscle using Percutaneous Transluminary Coronary Angioplasty (commonly referred to as angioplasty or PTCA) can be from 70 to 50% lower than the bill for the alternative treatment, Coronary Arterial Bypass Grafting (commonly referred to as bypass surgery or CABG). The whole field of non-invasive surgery is young. Hence, surgeons have an opportunity to develop reputations as pioneers in their field if they can complete important research studies, especially those surgeons practicing at research hospitals. Innovative studies include those that examine the performance of a different technique (or device) for the first time, or an old device on a new disease morphology. Surgeons at research hospitals, at any rate, are therefore quite open to innovation and are often device inventors themselves. Even surgeons who do not do research are keen to use the newest tools and furthermore have access to credible studies showing improved safety and efficacy. Hence, the market for medical devices is composed of, to a large extent, early adopters.

One reason innovation occurs is that a large number of dollars flow into medical research each year, so researchers uncover new applications at a rapid pace. The number of potential applications is enormous, given the complexity of the human body and the variety of disease-types identified. Recent advances in computer technology merely fan the flames from many directions. Examples range from magnetic resonance imaging, which allows detailed examination of the previously hidden structure of the body, to rapid prototyping techniques such as photo-stereo-lithography, which facilitates rapid development of prototype parts and manufacturing tools. Clearly, the resources to support basic research in this field exist in quantity.

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1 The researcher has worked as an Industrial Engineer and Manufacturing Engineer in the medical device field for nearly 5 years, and much of this discussion stems from his experience and training in the industry. The information is not applicable for all medical device manufacturers, and is especially suspect regarding more established products (i.e., stethoscopes) or products more complex than catheters (i.e., x-ray equipment).

Beyond high demand for products, economic advantage of new procedures, early adoption of innovation by the market, and a good many resources available for research, what drives the *pace* of innovation?

Medical devices are often disposable, made of plastic and fine metal, and are small and lightweight. Compared with some industries (for example, aerospace or chip making), capital requirements of production are low to moderate because many products require assembly labor, rather than automation, to make. While labor-intense processes make expenses can be high, margins are usually healthy. Though medical device companies can be small companies, with sufficient patent protection, they can sustain high margins and experience healthy cash flow and rapid growth. Entrepreneurs find willing sources of capital. The net result is that, compared with potential rewards, *barriers to entry are fairly low* (requisite patents, technical expertise and hospital connections notwithstanding). The key to getting started is innovation.

On the other hand, incumbents are vulnerable. With good development of a new idea and early and rapid market penetration, a small competitor can gain a large share of a growing market quickly. The principle method for erecting barriers to competition in particular market segments is patent protection. Keeping and even gaining market share in the face of competition from numerous upstarts principally involves being first to the market with innovative product design.

To summarize; high demand, economic benefit, early adoption of improved designs, resources supporting basic research, the recognized importance of intellectual property to market share gains, low barriers and high incentives to market entry combine to make rapid innovation the strategy of choice for most emerging medical device companies.

It is not merely innovation, but the *speed and efficiency* of innovation that is vital. The sense of urgency is driven by the very high cost of missing the first few months of the product sales-window and the very short product life-cycles involved (often two years or less).

Companies that have the capacity to iterate designs fast, solve production problems with dispatch, and deal with exceptionally short product life cycles effectively have an advantage over those companies that cannot. The ability to bring products to market quickly is widely viewed as paramount.

NEW PRODUCT DEVELOPMENT TASK TEAMS

Medical device manufacturers typically rely on teams to do new product development. This is so because of historical factors, structural factors and the requirement for speedy innovation.

Manufacturers decide to use teams because the level of complexity of some products requires involving members from multiple disciplines. Even if one individual could understand all the technical requirements involved,[2] one or two people could not do all the required tasks as fast as a competitor using multi-functional teams.

Furthermore, many of these manufacturers developed during a time when teamwork was promoted aggressively. These companies began from startups during the last 15 years, well after the Power and Politics school of management gave way to management philosophies focused on partnership, including Total Quality Management, Just-in-Time, and Design For Manufacturing. All of these philosophies involved a foundation of partnership and trust between previously antithetical constituencies: labor and management, customer and supplier, line and staff, design and manufacturing. While economic realities were clearly major factors, at least one observer notes the US had a difficult time responding well to the rise of Japanese quality and industrial capacity because, in part, the Japanese techniques were built on culturally reinforced foundation of partnership hardly practiced in Western industry. (Bernstein, in Kreitner & Kinicki, 1992, p. 405). These young companies grew, from the ground up, emersed in a paradigm of employee involvement, ownership and empowerment. Nothing in this paradigm suggests anything less than an all out multi-functional team effort will suffice to reduce time to market and improve quality.

Trust, Innovation and Competitive Advantage

INNOVATION REQUIRES CREATIVITY AND GOOD COMMUNICATION

Innovation is vital and teams are virtually required. Innovation, at a minimum, requires creativity. Teamwork, at a minimum, requires communication. Uess the team's members can

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2 To do so is very difficult, since one would have to know many technical areas, including patent and design disclosure, filing strategies, material science, process science, anatomy and physiology, marketing, production, packaging, training and distribution.

communicate among themselves and create as a group, teams cannot innovate. More to the point, we can infer that better in-group communication and creativity lead to more and faster innovation.

Innovation is not the same as creativity. Creativity is the generation of novel ideas, while innovation is the act of applying those novel ideas by bringing them to fruition (Badawy, 1988). Innovation is applied creativity, and so requires creativity at the outset.

Sometimes, individual engineers provide the big breakthroughs in design. Nevertheless, teams are formed to implement, and since teams figure out refinements in product and production system design, creativity is still involved. Teams are used to do the "fruition" part, and to accomplish the task, the members must communicate well. At a minimum, poor communication results in poor allocation of resources and task redundancy, hence, a slower pace of implementation. When communication is better, innovation is more rapid.

The nature of teamwork and the requirement to innovate rapidly put a premium on creativity and communication -- these two are essential to innovation.

TRUST MAY LEAD TO INNOVATION

Some casual observers would stipulate, on the basis of common experience (and I will attempt to show more rigorously later) that an increase in trust between teammates correlates with (or perhaps causes) an improvement in communication and creativity, and so improve the level of innovation.

LEADERS SEEK TO IMPROVE TEAM INNOVATION

Manufacturers use matrix organizational structures. Team leaders, generally associated with a product manager, lead new product development task teams. The team's members also belong to different line-organizations, complete with a hierarchy of supervisors and managers. The team leader assures product introduction under budget and on time while the line manager assures appropriate resources and appropriate administration of professionals and the tools, standards and policies on which they rely.

Both team leaders and line managers (henceforth, "*leaders*") seek to optimize team performance (speed and quality of innovation) by a number of interventions at the

organization, team and individual levels. For delicate situations (for example, those dealing with interpersonal trust), intervention at the individual level may be best.

Finally, leaders might be motivated to coach individuals in the hopes of increasing the level of trust on new-product development task teams. They would want to do this because trust may lead to increased creativity and communication, and these in turn increase the speed and quality of innovation.

TRUST CAN BE A BASIS FOR DIFFERENTIATION

Different companies have different levels of overall interpersonal trust[3] that may lead to different abilities to innovate. According to Porter (1985), for a firm to gain a sustainable competitive advantage over competitors it must:

1) have a difference with respect to competitors,[4]
2) the difference must MAKE a difference to the buyer (that is, the buyer's perception of received value must be different, and hence dispose her to buy from the firm)
3) the difference must not erode over time and must not be easily copied by a competitor .

Companies develop different competencies which support and provide competitive advantages whenever the competencies influence the value ultimately delivered to the customer. In the industry under study, the customer values innovation, so any competency one manufacturer has that increases innovation and meets criteria 1 and 3 (above) constitutes a sustainable competitive advantage. Managers, accordingly, can look to trust as a potentially important source of differentiation from other manufacturers.

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3 A precise definition of this concept is wanting in this discussion. However, I have in mind an "atmosphere of trust." Where an atmosphere of trust exists, I would expect people to report they trust others more and are trusted by others more than in places where such an atmosphere is lacking. Furthermore, I might also expect trust-building behaviors and cultural sanctioning mechanisms to be more prevalent (frequent or forceful) in such an environment. Alternatively, a place with higher overall levels of trust might be inhabited by people who score high on a psychometric measure of trust in other people in general.

4 For purposes of this argument, "cost leadership" (achieving a cost leader strategy) is included as an important difference.

A HIGH LEVEL OF TRUST IS DIFFICULT TO COPY

Seeking interpersonal trust through careful recruitment is one thing. However, given a particular team in place, teaching and coaching for interpersonal trust is difficult at best. Mitchell (1990) suggests that adolescents can develop trust, with counseling, and offers a method that includes assertiveness training and direct coaching. Goleman (1995) explains that when parents are attentive, the opportunity to develop emotional intelligence (and associated social skills like trust-capacity) continues through the adolescent years. However, people develop trust-capacity early in life; trust involves the "old brain," hence ideas and notions about the trustworthiness of others are stored primarily as vague emotional images. These findings suggest that leaders will have a difficult time changing the fundamental attitudes group members have about the generalized "other". On the face of it, many if not most group leaders would balk at coaching to change such deeply held beliefs.

Teaching employees to trust each other may be difficult, but not impossible. Industry participants can purchase courses for their employees; Trust building techniques and courses are available to all competitors, and in emerging industries with high margins and where employees are ready and eager to learn, companies are in a good position to take advantage of these courses.

While a high level of trust among employees itself might resist imitation, the *results* of trust (communication and creativity) are perhaps less difficult to duplicate. We might argue that a deep level of trust (the kind one might find in a "skunk works" operation) might lead to unique kinds of communication and creativity that are themselves hard to copy. The following possibility, however, cannot be refuted: that the advantage of the "trust-leads-to-innovation" mechanism, while probably difficult to copy, may nevertheless be easy to circumvent. Except for this: courses in communication skills and creative problem solving abound, yet on the face it seems likely we can question their long-term efficacy, given an environment otherwise low in trust.

To sum up, teaching trust and unlearning distrust is hard. However, I remain optimistic that people can, with persistence and sensitivity, change their trust beliefs and resulting behaviors. To the extent they can, and it is difficult to do, the company that does accomplish it gains a competency difficult to copy.

To the extent that high levels of trust lead to better communication and more creativity in a group setting, and to the extent those improve innovation and time-to-market, the company in such a position will have a competitive advantage.[5] To the extent that the mechanism is hard to copy, or the benefits are not achievable by easier means, the advantage is sustainable. So finally I conclude it is feasible that high levels of trust have a role in achieving sustainable competitive advantage.

Forward

The following chapters explore the practical problems leaders can find when they want to help their co-workers learn to trust one another. The relationships among trust, communication and creativity are unclear, yet a careful review of current and emerging research from several disciplines reveals this - that *we should find a positive correlation between trust and communication, and between trust and creativity.* Survey research methods on a sample of medical device industry workers test this hypothesis. Along the way, we discover many interesting relationships and gain insight into the mechanisms that govern some important aspects of human interaction.

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5 Competitive advantage in one area does not guarantee pre-eminence in the market, or even long term survival. For example, one company held a patent for many years to a particular catheter design that allowed increased flow of blood through the artery during the procedure and the company was able to successfully develop the product, deploy it and defend the patent. Regardless of the capability competitors may have had in developing such catheters of their own, including high levels of trust, communication and creativity, the patent holder retained the competitive advantage in this market segment.

Problems and Questions

A Practical Problem

Leaders (both new product development task team leaders and line organization managers) know that the quality of group processes like communication and creativity determine the team's ability to innovate quickly. These leaders attempt to improve team processes for many reasons, including to decrease time-to-market. Accordingly leaders would like to enhance the amount of trust on new product development task teams.

Leaders can choose to intervene at one of three levels: organizational, group or individual. As a practical matter, leaders who attempt to influence the whole team at once may find the task difficult to accomplish, uncomfortable, or both. They may find opportunities to intervene at the group level hard to come by; delicate group interventions are best accomplished only when the group is assembled (memos, voice messages and electronic mail notwithstanding). When groups do meet, leaders may find it awkward to deal with the assembled group because they must track many issues and variables all at once. Some leaders are much more comfortable "one-on-one" versus "many-on-one". Because some issues are delicate (with the potential for generating interpersonal conflict between team members), leaders have little choice but to deal with the situation "off line". Consequently, leaders often need "one-on-one" techniques.

A practical problem arises. Because team leaders don't understand well the linkages between trust and innovation, they don't know if or how they can coach individuals for trust, and so find it difficult to intervene at the individual level with confidence. As a result, leaders are left with company and group level interventions that are not appropriate for all situations.

A review of the literature

While people seem to agree on what trust *is* and what makes some people more trusting than others, researchers are not clear on whether trust and creativity go hand in hand.

THE BASICS ABOUT TRUST

Julian Rotter, a researcher at the University of Connecticut, defined trust as

> ...an expectancy held by an individual or group that the word, promise, verbal or written statement of another individual or group can be relied upon. (Rotter, 1967)

In social psychology literature, interpersonal trust is measured as a trait (characterstic of an individual persisting over time) (Cook & Wall, 1980; Rotter, 1967). When measured as a trait, trust is a belief not about specific others but about human nature in general. (Wrightsman, in Robinson, Shaver & Wrightsman (Eds.), 1991) People divide into high or low trusters. Most people view the ability to trust others as "a hallmark of good social adjustment " (Gurtman, 1992; see also Mitchell, 1990).

TRUST AND CREATIVITY

Does more trust lead to more creativity? Researchers provide conflicting evidence.

Goleman (1995) describes a set of competencies that, together, determines a person's level of Emotional Intelligence, (EI). He claims a person's "emotional intelligence" is a better predictor (than standardized intelligence test scores are) of a person's social adjustment and success. Yet if both EI and trust are hallmarks of social adjustment, then we might conclude EI and trust ought to correlate. However, Badawy (1988) says creativity is largely an individual effort -- that creativity from group interaction is rare. The most creative people tend to be loners, paying "scant attention to the everyday demands of society" and they are "introverted, non conforming" (Badawy, 1988). Some of us have run across creative people who can't seem to get their ideas off the ground. Creativity does not imply the social acuity involved in implementation, but EI does predict social acuity well (Goleman, 1995). As a result, it seems creative people are often "loners", low in EI, while people who trust others readily would most often be the socially adept, high in EI.

Some creative processes require both collaboration and trust. Hardwig (1991) argues that interpersonal trust is the basis for much of our knowledge, and sites research processes[6] that

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6 Hardwig's two examples were: in physics, a project that required 99 physiciansto determine the life span of a charm particle, and, in mathematics, de Branges's proof of Ludwig Bierbach's Conjecture.

require teamwork because researchers must bring together knowledge from different specialties. Another interesting example is a study of auto manufacturers worldwide requiring the efforts of more than 100 researchers over at least a 5 year period (Womack, Jones & Roos, 1990). One strictly group-based problem solving technique (Wilson Learning Corporation, 1991) requires that collaborators suspend their judgment to enhance creativity in a group setting. Indeed, during this method, participants are given *specific* ways in which to 'build on other's ideas'. Brainstorming, a widely used creative process, is specifically designed for groups. In summary, groups seem to require trust to nurture in-group creativity.

Because the work is dangerous and underground, miners form work groups characterized by very high levels of interpersonal trust and cohesion. Miners must predict each other's responses under extreme circumstances. Vaught and Wiehagen (1991) studied normative and emergent perspectives which miners developed during the evolution of a mine fire and subsequent evacuation. They illustrated the shift from normative to emergent perspective and showed that both the perspectives 1) were strongly influenced by the prevailing sociotechnical system, 2) the particular nature of the emergent perspective was also related to the particular nature of the immediately preceding normative perspective and 3) that people were less creative during the development of events (alarm, shutdown, evacuation, rescue) in part because of the conflicts raised in the emergent perspective stemming from (normally) high trust. A high level of trust, then, can sometimes impede creativity.

Trust may reduce creativity through the mechanism of "groupthink". Higher levels of trust lead to higher levels of group cohesion, or at least this is a reasonable assumption. However, Kreitner and Kinicki (1992) describe victims of "groupthink" as "friendly, tight-knit and cohesive." Manz and Sims (1980) note that when a group is highly cohesive and the members have a strong desire to conform (agree with each other), then potentially "...a deterioration of mental efficiency, reality testing, ... moral judgment [and] ...critical thinking [will result]."[7] I suggest we add creativity to this list of deteriorating mental processes, because people expressing creative ideas by definition challenge (to some extent) common perspectives (i.e., they are non-conforming). The existence of groupthink suggests that trust can reduce creativity in groups.

In summary, the researchers have provided conflicting conclusions, and we don't know if high trusters are more likely to engage in creative behavior, or, as in the coal mine and "groupthink" examples, being part of a high-trust group actually impedes creativity.

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7 Janis, 1971 and 1972 (in Manz & Sims, 1986).

TRUST AND COMMUNICATION

It may seem obvious that higher levels of trust will lead to better communication. However, as with creativity, the story is unclear. For example, a Russian study by Ratajczak and Jagoda, (1984) found that 5-member groups composed of high trusters, when observed using Bales' technique, did not communicate more effectively than a similar group of low trusters did. With respect to non-verbal communication, trust expectancies did *not* correlate with non-verbal sending accuracy, but *did* correlate with non-verbal receiving accuracy (Sabatelli, Buck & Dryer, 1983).

Communication involves the sending and receiving of information between people. More generally, communication is an interactive process made of one-way components; A sends message to B and C, C sends message to D and F, E sends message to B and so on. For each component to occur (i.e., A sends message to B), A must accurately translate the message, B must contend with various external and internal sources of noise, and then B must construct meaning from what she hears and observes. Does trust somehow allow "cleaner" translation. Does trust lead to reduced noise, or improved capacity to deal with noise? Conceivably, high trusters might communicate worse because they may have different expectations of a trusted other leading to less accurate translation, or more tolerance of noise. The point here is that the literature does not appear to address, much less resolve, the role of trust in information exchange.[8]

In summary, more trust MAY lead to more creativity and better communication, but the literature is unclear and the mechanisms involved uncertain.

The Research Problem

I have previously shown that leaders have the problem of understanding how to coach individuals for trust. This is a problem for *team leaders*.

In the present study, the *researcher* has a slightly different problem. After the discussion so far, we can claim communication and creativity are key to innovation, but we need a deeper understanding of the nature of trust and the relationships among trust, creativity and communication, and the mechanisms involved. Without such an understanding, we cannot

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8 ...with the dual exceptions regarding the amount of intimate information rendered (disclosure) and the quality of married life, where the prevailing consensus appears to be that more disclosure leads to more satisfaction with marriage.

verify higher trust will *lead* to innovation and, further, we will have a tough time developing good one-on-one interventions that we can use with confidence. If we understood the relationships better we could coach for increased trust and (potentially) enhance strategic advantage.

The Research Question

Broadly, we want to know how trust relates to communication and creativity in work groups. We want to focus on cross-functional, new product development task teams operating in the medical device industry. Such teams operate in a highly task-oriented, schedule driven environment, where high levels of commitment, cohesiveness, communication and creativity are generally believed to be ingredients of success.

More specifically, we want to know the answers to these research questions:

1) Is a high level of trust correlated with the quality of communication?
2) Is a high level of trust correlated with creativity?

Background

Most people share general[9] ideas about trust and creativity, but these are not precise. For our purposes, we must pin down the details of both of these intangibles, together with the (relatively observable) process of interpersonal communication, as they are quite important in most human affairs, and especially in business and public life.

Trust is a belief and a behavior

Rotter (1967), working from a basis of "Social Learning Theory", defined trust as the generalized expectation that the word of another is reliable. Trust is an ascription made by one person about the *benevolence, competence* and *truthfulness* of another (Gurtman, 1992). Rotter, then, called trust an ascription -- essentially, an interpersonal judgment of a special kind, something one person says about another. When you or I say about another 1) "she says she will do X, and I believe she is *telling the truth*, and 2) I believe she is *able* to do X and 3) regardless, *she will not try to hurt me*," then we are trusting the other person. The expectation involved is generalized; Rotter is not talking about making predictions about a particular person and event, but assumptions about most people in many situations. To summarize, Rotter saw trust as a belief.

Dale Zand (1972, in Kreitner & Kinicki, 1992) found trust is more than a belief; Zand noted that trusting someone is a *conscious act* of making oneself vulnerable to someone else. As an example, imagine a dog-owner coming home. The owner walks through the door thinking, "My dog won't hurt me." She has satisfied Zand's criteria for trusting (in this case, an animal). Interestingly, if the owner walks through the door preoccupied with other thoughts, then she fulfills Rotter (making an ascription, albeit implicitly), but not Zand (who requires the owner perceive her vulnerability). To summarize, Zand sees trust as behavior.

There is a kind of trust not covered by Rotter or Zand -- one that is neither belief nor behavior. Social psychologists break "attitudes" down into cognitions, emotions and behaviors (resulting from both cognitions and emotions.) However, it is interesting to consider the following example. While driving a car, most people, for example, trust most other drivers

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9 Many people will not have thought much about either construct in detail. When one person thinks about trust, they might (for example) see a picture of a close friend, or a pet. With respect to creativity, another person might consider the concept and visualize an artist throwing a pot, or a mechanic figuring out a car that won't run.

to drive well ("they are competent"), not try to run them off the road ("they are benevolent"), and follow through when signaling ("and they are truthful"). Most of the time, these "trusters" neither make an ascription (implicit or otherwise) about the other drivers, nor are they conscious of their vulnerability. Other drivers are just part of the environment. At some point, people's cognitions and emotions (or beliefs or ascriptions) become to such an extent unconscious in nature that they fall out of the categories of trust explored by Zand and Rotter -- they become part of the underlying social contracts that govern our adapted behavior.

However, I am not exploring the latter of trust here. Instead, I am interested in the kind of trust that arises after someone has had a chance to learn something about the other person or group.

The distinction drawn, however, is virtually pointless, or maybe it is better to say that we can safely ignore the "ascription" and "consciousness" elements of the previous definitions. Research indicates we collect, evaluate and use lots of information all unconsciously (Goleman, 1995, pp. 54-55). Trust is likely a mechanism that itself allows us to free up mental resources in pursuit of other tasks. In the end, we should think of trust as a process using, at best, partial information and operating at the level of consciousness only for short periods.

Trust, then, is both a belief about another, and a behavior based on those beliefs.

A deeper understanding of the trust construct

STATE VS. TRAIT AND HIGH VS. LOW TRUSTERS

While we can think of being in a trusting relationship as a *state* (varying from situation to situation), the capacity to form such relationships readily is a *trait* (varying from person to person, with respect to each person, persistent over time and in different situations). The distinction is important in the literature (Gurtman, 1992) and in the present study.

Several measures have been developed to measure trust-related constructs (Gurtman, 1992) including Rotter's Interpersonal Trust Scale (ITS) (Rotter, 1967) and the Survey of Cynicism, the Mach IV Scale, the Faith in People Scale and the World Assumptions Scale as examples. Rotter found a large affective component to trust, so he views the ITS scores as an indicator of trust-trait -- the propensity or capacity to trust others. People who score high on the ITS can be thought of as high trusters while their counterparts are low trusters. Gurtman (1992) viewed people who scored 1 standard deviation above and below the mean ITS score, respectively, as high and low trusters, though other cut-offs can be employed.

TRUST IS GOOD FOR INDIVIDUALS AND GROUPS

One might wonder if some people trust too much. However, trust is not correlated to gullibility (the tendency to trust others without information, or ignoring contraindication) (Rotter 1967, 1980) and high trusters do not disproportionately report problems with gullibility, as we might expect (Gurtman, 1992).[10]

Individuals who trust are better off. Mitchell, (1990) citing several studies, reported "interpersonal trust is related to psychosocial competence." Maladjustment and low trust, as measured by the Incomplete Sentences Blank (see Rotter & Stein, 1970, in Rotter, 1971) and by the ITS respectively, are correlated. Meanwhile, people who trust more are *more liked by others* (Hochreich, D. J., 1977, in Rotter, 1980), and are *more confident, less lonely* and *more popular* than low trusters (Mitchell, 1990). Cradick (1975, in Mitchell, 1990) found interpersonal trust and openness tend to enhance a sense of self-worth. Gurtman (1992) found that high trusters report fewer interpersonal problems like being domineering, vindictive, cold, socially non-assertive, exploitable, overly nurturing and intrusive.

Distrusters are worse off. Adolescents who don't trust others are less confident, less popular with others and more lonely. Without trust, cooperation, humor, caring and sharing are all low, and planning is poor (Mitchell, 1990). Gurtman also found low trusters reported far more problems than their more trusting counterparts, especially problems associated with being *cold* and *domineering*, including being overly competitive, vindictive and resentful. Subjects scoring low on a trust scale scored higher stress scores (Schill, Toves & Ramanaiah, 1980), supporting the notion that distrusters experience more stress, while trust was associated with "feelings of control over one's own life and interpersonal affairs."

Trust is good for the work group as well. Kouzes and Posner (1987) found that trust in supervisor was important in work unit productivity (Deluga, 1994). Kumar and Ghadially (1989, in Kreitner & Kinicki, 1992, p. 408) found that in East Indian Government Organizations, higher trust correlated with lower organizational politics. Organizational citizenship behaviors (OCBs)[11] are important to organizational health. Eleven supervisor trust building behaviors (STBBs) have been identified, and each of them correlates with high trust (Butler, 1991 in

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[10] Gurtman suggests that gullibility might be related in some way to dependency instead. (Gurtman, 1992)

[11] Organizational Citizenship Behaviors are "elective extra-role behaviors" that are required because, invariably, organizations face situations for which pre-ordained (job description) behaviors are inadequate.

Deluga, 1994, p. 317) and OCB (Deluga, 1994). STBBs lead to increased subordinate OCB (Deluga, 1994).

Finally, trust is vital to society.

> It is belaboring the obvious to discuss the significance of interpersonal trust in our society...The entire fabric of our day-to-day living, of our social order, rests on trust -- buying gasoline, paying taxes, going to the dentist, flying to a convention -- almost all of our decisions involve trusting someone else.
>
> (Rotter, 1971)

Hence, trust is good for the individual, the group, and society. As a result, we should remain motivated to study the construct of trust in detail.

Relationships among trust and other phenomena

TRUST AND SOCIAL COMPETENCE

As discussed previously, trusters experience more social success than low trusters do. They have a better sense of self worth, report fewer interpersonal problems, are less lonely and more popular. Distrusters, by contrast, report more interpersonal problems than trusters report.

TRUST, WARMTH, SUBMISSIVENESS, POSITIVE AFFECT AND POSITIVE MOODS

Trusters are warmer and more submissive. Using a type of circumplex[12] analysis (refer to Exhibit 1), Michael Gurtman (1992) demonstrated that trust is related to love (versus coldness)

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[12] The circumplex is a disk shaped model with octants defined on it, in Cartesian space. The x-axis represents the continuum from warmth (at 0 degrees) to coldness at 180 degrees, while the y-axis represents the continuum from dominance (90 degrees) to submissiveness (270 degrees).

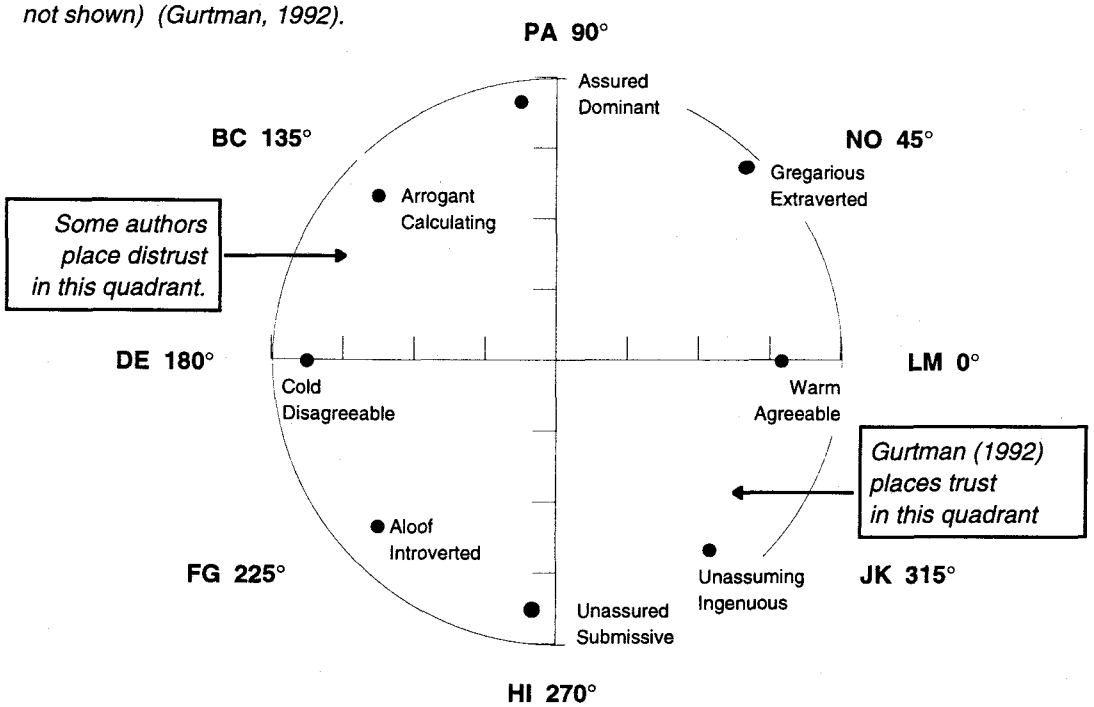
Gurtman (1992) places trust in the warm/submissive octant, (at approximately 315 degrees) and distrust in somewhat the opposite octant (104 to 166 degrees, though some authors argue distrust should be placed in the hostile/submissive octant, approximately 225 degrees.)

and submissiveness (versus dominance). People who score higher on the ITS appear to be warmer and more submissive than others. "Positive Affect reflects the extent to which a person feels enthusiastic, active and alert." (Clark & Tellegen, 1988) Relative warmth, and submissiveness, according to the circumplex model, predict the absence of many interpersonal problems as well as higher Positive Affect (which is in turn linked to positive moods).

Exhibit 2 illustrates the linkages discussed so far.

Exhibit 1

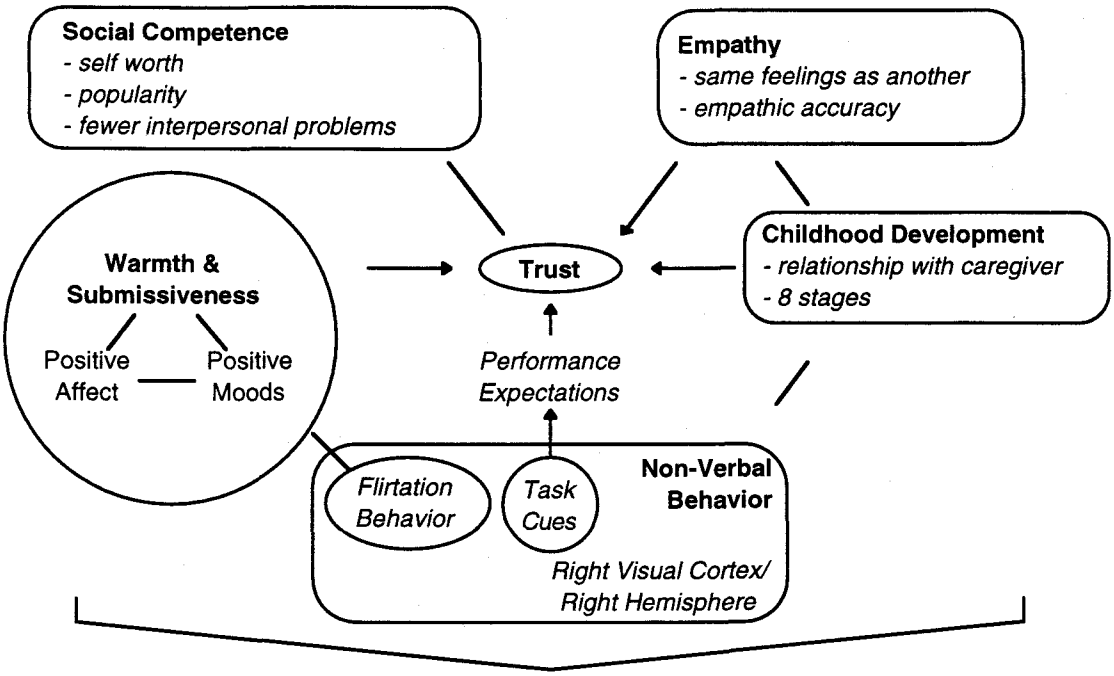
Interpersonal traits and problems are both associated with position on circumplex. For example, trait arrogant/calculating and problems of vindictiveness (not shown) are associated with each other, predicted because both are associated with quadrant BC. Surprisingly, Trust (quadrant JK) not associated with problems of exploitability (also JK, not shown) (Gurtman, 1992).



From Wiggins, Phillips & Trapnell, 1989, in Gurtman, 1992, Figure 1, p. 991.

The interpersonal circumplex model of interpersonal behavior

Exhibit 2



SUMMARY: Trust, empathy and ability to interpret non-verbal behavior all develop in early childhood. Non-verbal communication and empathy lead to trust. Signalling warmth and submissiveness leads to trust. Flirtation behavior is an example: 1) intended to develop trust, 2) signalling warmth and submissiveness, 3) non-verbal, 4) exhibited in early childhood for other reasons. Trusters tend to be more socially competent.

Relationships among trust and the antecedents of trust

TRUST AND CHILDHOOD

Erikson (1963, in Mitchell, 1990) sited eight stages of early childhood development, and the first stage, development of *trust* (as a social skill,) occurs in the first 18 months of life. A child forms her basic assumptions about how friendly the world is, and how and when to trust another, based on the quality of her relationships with the main child care providers during this time. Rotter (1967) draws a distinction between Erikson's "Basic Trust" and his own definition.

Interestingly, memories formed during this period are almost completely emotional in nature, because the parts of the brain responsible for cognition and reason (the neocortex) are not nearly as well developed in the pre-toddler (Goleman, 1995). Hence some events that trigger fear, anger, or even milder emotions, (i.e., feelings of mistrust), may do so because they facilitate access to our earliest memories. Because such memories are wordless and non-specific, we can find this emotion-triggering process difficult to later diagnose, understand and deal with constructively.

Hence it is plausible that the ability or inability to trust is very "deeply ingrained" and may be difficult to alter.

TRUST AND REPRESSORS

Some people can tune out emotional upset, and these people qualify as "repressors" (Goleman, 1995). Such people block negative emotions (like fear) before they consciously experience it. While these people have measurable *physiological* responses to upsetting conditions, they appear to be *unaware* of their negative emotions. Though this happens to some extent in almost all of us (most emotional response is below the level of awareness), still about 1 in 6 "repress" very negative emotions. Given a sentence completion test, including sentences designed to give rise to negative imagery, these people will tend to complete the sentence in upbeat ways.

It seems possible that repressors are, on average, higher trusters. For example, a repressor, upon meeting a generally trustworthy, but currently angry person, is more likely than a non-repressor to repress feelings of fear or threat, and provide charitable explanations for the angry behavior. (We should note the imagery test does not necessarily imply the repression mechanism occurs in other situations -- for example, real-time social interaction like the one described here.) One of three requirements for trust has been met: the ascription of benevolence. Of course, the same argument holds concerning gullibility, yet other research has shown that gullibility and trust do not correlate. We cannot conclude repressors trust more readily than others do without further evidence.

TRUST AND EMPATHY

Empathy means the ability to experience another person's feelings (Goleman, 1995; Mehrabian & Epstein, 1972) and is distinct from sympathy, which is a generalized feeling of concern for another because of the other's feelings.[13] A potential truster needs to know about the other person's feelings, because he needs to draw some kind of conclusion about the other person's benevolence or honesty. In a study of the ability of spouses to determine each other's thoughts and feelings, Levinson, (in Goleman, 1995, p. 104) at UC Berkeley, measured physiological responses of both spouses; one spouse was videotaped and, subsequently, the other spouse watched the tape. He measured both spouses physiological responses, and he found the spouses were more accurate when their physiological responses were similar. He termed the phenomenon "empathic accuracy". Hence we can expect that people with more empathy can predict other's thoughts and feelings better, hence predict behavior better, and so might trust more readily. Empathy may make trusting easier.

Marian Radke-Yarrow and Carolyn Zahn-Waxler, (in Goleman, 1995, p. 99) at the National Institute for Mental Health (NIMH), observed empathetic reactions in infants and toddlers, for example, crying in response to another child's injury. Most children show signs of caring, sympathy and empathy somewhat uniformly until about 30 months, at which point they appear to diverge, some showing more and some showing less of each quality. So empathy and trust relate in another way, they appear to both develop very early in life. Do trust and empathy both involve the same neural circuitry? Maybe they do.

TRUST AND NON-VERBAL BEHAVIOR

In general

Exactly what constitutes non-verbal (or non-vocal, or non-auditory) behavior is open to interpretation (Knapp, 1978). For our purposes, we can think of non-verbal behavior as any behavior not involving words spoken or written. Generally, these behaviors are quite transient

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13 Actually, some controversy exists. Cognitive empathy is the ability to cognitively take the role of the observed person and accurately predict the other's emotion. Emotional empathy, by contrast, involves actually experiencing the other's emotions. Social acuity would seem to be enhanced more by actually experiencing the other's emotion -- we use emotional empathy in this study. (See also Mehrabian & Epstein, 1972)

and sometimes unconscious. People use non-verbal behavior to accomplish many things, some intentional and some unintentional. Sometimes people send unintentional messages to the people they are with, including relational messages (i.e., messages that transmit how the two people involved are related).

People send relational messages using non-verbal behaviors, and some behaviors transmit messages concerning the level of trust people have for one another. For example, Burgoon (1991) found that a given non-verbal behavior sends multiple meanings that people then interpret in context. Burgoon says context includes message-moderating factors such as the gender of the sender, the gender pairing involved, sender attractiveness, and difference in status between sender and receiver (status gradient). Specifically, handshakes are unique among non-verbal behaviors in signaling trust and formality at the same time, while increased proximity sent a strong message of "relaxed, similar, dominant." An increase in amount (or difference in type) of touch tended to increase perceived composure, a sense of immediacy,[14] affection, similarity, and informality. People using non-verbal behaviors in combination send more than the sum of individual meanings, they tend to amplify the message involved. Hence, people send strong messages about how much they trust others by using non-verbal behavior.

As we noted before, the perception of other's trust of us seems strongly related to the ability to "read" other's non-verbal behavior. Brothers (in Goleman, 1995, p. 103) found that the right visual cortex (RVC) was responsible both for detecting the emotional content of facial non-verbal behavior in primates (for example, grimaces) and for communicating with the amygdala, the center for emotion, and hence for empathy. Brothers found that certain groupings of neurons, were responsible for certain emotions. Brothers found primates experienced the same emotions as a companion experienced when the subject viewed the companion's facial expression (of pain, via closed circuit television), and the subject acted to relieve the companion's pain, demonstrating altruism. Non-verbal behavior and empathy appear physically (or rather, biologically) linked through neurological connections.

This research explores the following idea: trust depends on empathy, a person's ability to feel what another feels, and empathy relies on a person's ability to understand another's emotional state through non-verbal communication.

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14 "Immediacy" is "a term used to represent openness, warmth, closeness, and availability for communication." (Kreitner & Kinicki, 1992, p. 448).

Task cues, dominance cues and performance expectations

Driskell, Olmstead and Salas (1993) found that people quickly form status judgments, yielding status gradients among group members, during the first few minutes of group formation (and sometimes before)! Status gradients (as measured by actual influence) are based, in large part on performance expectations. Driskell, et al, describe task cues and dominance cues, special classes of non-verbal behavior.

For example, a person exhibits *task cues* when they speak more often, with fewer verbal disfluencies, maintain eye contact, or choose certain positions at a table. Interestingly, when a person exhibits more task cues, others tend to increase their expectation of the person's performance. When people exhibit *dominance cues*, on the other hand, they do not trigger the same effect. Truthfulness and benevolence considerations aside, according to Rotter's (1967) definition, task cues ought to lead to ascriptions of competence, and hence, trust, but dominance cues should not.

Flirtation behavior

An interesting parallel exists. Givens (1978), found non-verbal flirtation behaviors fall into two categories: those that signal *affiliation*, or a willingness to form a social bond; and *submissiveness*, intended to communicate the absence of danger. Givens' thesis is that, to some extent, all vertebrates require these messages, and they use a core set of non-verbal means to send and receive them, because vertebrates (unlike most non-vertebrates) require proximity to reproduce while at the same time use distance from enemies for defense and other purposes. Such signals also seem to resemble child-like signals for parental help (Givens, 1978). Affiliation and submissiveness signals probably develop in early childhood, aid in survival, and are subsequently used during flirtation. Along with the similarity of skills used in childhood and adulthood, what is striking is the similarity of such signals across many forms of vertebrates. This evidence leads to the possibility that a common non-verbal language among vertebrates enhances system-wide efficiency.[15] Another possibility is that mechanism

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[15] This idea is an intriguing possibility for future research in two areas: natural systems and interacting intelligent (computer) agents. For example, one could set about identifying the effects on an ecosystem of enhancement or interference of non-verbal message interpretation among different species. Would miscues over the (very) long haul contribute significantly to advance or decline of species? Maybe. Would they contribute general systemic breakdown? In an ecosystem where there was NO non-verbal communication,

facilitating non-verbal message interpretation depends on the "old brain", the structure or structures shared by many vertebrates, rather than the "new brain", which may be relatively differentiated among vertebrates.

Flirtation behavior, then, is like trust-building non-verbal behavior in general -- both sets signal warmth and submission. Givens found complex forms of flirtation behavior are involved in forming all sorts of social bonds, including those at work, provided the behaviors are accompanied by appropriate disclaimer behavior. Interpretation of all communication (including flirtation behavior) is problematic because of the presence of noise. Noise can take the form of incongruities between the setting and behavior; people may find unmitigated affiliative behaviors in a business setting unacceptable. That is, people may develop expectations of behavior from knowledge of the setting.

Noise can also take the form of target pre-disposition, some derived from personal history, some from cultural norms. The concepts of "personal space" and "intimate space" are discussed widely and can vary between cultures and among individuals within a culture. A distinct possibility is that trusters admit more affiliative/submissive behavior than others.

These results reinforce that trust of others develops in early childhood. They also suggest children develop non-verbal means of gaining the trust of others (parents) very early, and that they continue to rely on these skills later in courtship and in forming other social bonds. All this depends on the ability to signal (and interpret signals of) warmth and submissiveness, which may rely in turn on the ability to actually be warm and submissive.

Finally, both trust and empathy, as noted before, develop in early childhood. It is virtually certain that empathic responses require attunement to non-verbal behaviors of others (Goleman, 1995; Begley, 1996). Trust and empathy, then, are further related to each other because they are both related to non-verbal behavior.

TRUST, NEUROLOGY AND EMOTIONAL INTELLIGENCE

Daniel Goleman, (1995), writing about the idea of emotional intelligence, identifies five broad competencies that serve as good predictors of success in life,. These competencies help people interact well with others, build strong, lasting relationships, and flourish in a society that often demands teamwork and cooperation. Together, these competencies form "emotional intelligence" (EI), and they include:

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would a subclass of vertebrates that developed such communication gain an advantage, other traits (aggression, stamina, helping ability) being equal?

1) being able to know one's own feelings as they happen
2) being able to handle feelings and express them appropriately
-- soothing oneself, dealing with failure...
3) being able to "marshal" ones own emotions in pursuit of a goal (related to
-- persistence, delayed gratification, being comfortable with ambiguity)
4) being able to manage the emotions of others in relationships
-- empathy, caring, altruism
5) handling relationships (Goleman, 1995)

The relationship between empathy and trust has been noted already, but what about the other competencies that make for an emotionally well adjusted person. Is emotional well-being linked to high levels of trust, or trustworthiness?

Emotional intelligence is linked to all the things we've discussed so far. Erikson (1963, in Mitchell, 1990) noted that the capacity for trust in others is "widely assumed to be the hallmark of social adjustment" (see also Rotter, 1971; Gurtman, 1992 and Mitchell, 1990). Goleman (1995) notes the same connection between emotional intelligence and social adjustment. Being generally warmer and more submissive (landing in a particular place on the Gurtman's Circumplex) is correlated with having fewer interpersonal problems -- so is more emotional intelligence. It seems skill number two, above, would naturally lead to positive moods more often (though not necessarily a positive affect). Finally, it is not reaching too far to presume someone more comfortable with ambiguity and better able to understand others' transitory bad moods might form trusting relationships more readily, and that such relationships would have more resilience in the face of occasional negative behavior. The emotionally well equipped would trust more often, and hence would be trusted in return.[16]

However, as there are no measures of emotional intelligence per se, so there are no correlation studies that link EI with measures of trust. So, while a strong connection seems almost certain, concluding anything more than a general relationship seems speculative.

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16 Indeed, supporting evidence is provided by Rotter (1980) who found trusters are rated by others as more trustworthy.

Thesis

The main thesis

It is likely that *increased interpersonal trust leads to better communication and creativity in work groups*. Better communication and creativity tends to increase innovation. In emerging industries *based* on innovation (the medical device manufacturing industry is an example), a *sustainable* level of increased innovation can be a strategic advantage. To the extent that it is difficult for competitors to build high levels of trust, the advantage is sustainable.

It is very difficult to change fundamental beliefs and behaviors. Nevertheless, work group leaders may gain some of this advantage through coaching and managing for increased levels of interpersonal trust.

Trust and creativity

INCREASED TRUST LEADS TO INCREASED CREATIVITY

Trust leads to cohesion, and therefore, creativity.

Creativity (in the workplace) is not the same as innovation (Badawy, 1988, p. 63). When someone creates, they generate novel thoughts and ideas; when they innovate, they bring those ideas into the real world and into use. Bach writes a symphony and we call it creativity. When he performs for an audience, we should call it innovation. Innovation is different from just implementation, though. There are differences among performers - some artists interpret the work, perhaps by interpreting Bach himself - such a performer is innovating. Innovation requires and involves the act of creation. (See also Brown & Karagozoglu, 1989)

Researchers study group cohesion with interest. Cohesion is a group-level phenomenon. Members of a cohesive group develop a sense of "we-ness". The members of a cohesive group are reluctant to leave the group -- they stick together and "derive emotional satisfaction from participation in the group" (Owen, 1985 in Kreitner & Kinicki, 1992, p. 408).

Vaught and Wiehagen (1991), studying social organization in a coal mine, found that coal miners form highly *cohesive* social bonds typified by the same "we" feeling discussed above, and a strong social-norm enforcement process leading to a shared set of values. For the miners, "sticking together" in difficult situations is a sacred code. The miners may become so committed to each other because of the situation: the environment is so dangerous that miners have a strong need to predict other miner's behavior with accuracy. The miners need to form "buddy" relationships. Trust and cohesiveness are fundamentally intertwined, at least among coal miners. Does this finding extend to other types of work groups?

It may. Kollock (1994), studying the emergence of stable economic exchange relationships, found that in simulated exchange relations involving uncertainty,[17] buyers tended to value reputation more and form commitments to sellers with good reputations.[18] Consequently, it became possible (though not necessary) for trust to develop. More powerfully, at the

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[17] This was found where the people involved had asymmetrical information about the other and where the buyer was vulnerable to the seller (i.e.; deceit and opportunism were possible). (Kollock, 1994)

[18] Kollock is careful to distinguish between the kind of commitment he studied (behavioral) and other notions of commitment (i.e.; moral obligation, feeling of attachment).

conclusion of Kollock's experiment he noted subjects (undergraduates) who had developed committed exchange relations during the experiment sought each other out for "real life" social engagement afterward. Kollock's work demonstrates that "sticking together" and trust increase together in this special type of market relationship.

Deluga (1994), quoting other studies and describing Leader-member Exchange[19] Theory (LMX), notes that among a set of supervisor-subordinate dyads, higher and lower quality "exchanges" (patterns of interaction) will develop, and that the higher-quality exchanges 'are friendly working relationships typified by mutual trust, interpersonal attraction, loyalty and commitment.' (paraphrase, Deluga, 1994)

It is clear, then, that groups with higher levels of trust are also cohesive. Furthermore, O'Keif , Kernaghan and Rubenstein (1975, in Keller, 1986, p. 716) found that cohesive groups tend to adopt more innovations than groups with less cohesion.

So we can see that trust correlates with group cohesion and cohesion correlates with innovation, (and by extension, creativity). Hence, interpersonal trust is likely to correlate with creativity.

Trust leads to better moods, and therefore, creativity.

As previously discussed, attitudinal factors and situational factors influence trust. Researchers distinguish between trust-trait and trust-state. Similarly, positive affect (PA, a trait) and good mood (a state) are different.

Positive affect is a personality factor that takes in sociability, extroversion and social boldness (George & Brief, 1992). Tellegen (in George & Brief, 1992) states that people high on the PA dimension "...have an overall sense of well-being, viewing the self as pleasurably and effectively engaged... ."

> Briefly, Positive Affect (PA) reflects the extent to which a person feels enthusiastic, active, and alert. High PA is a state of high energy, full concentration, and pleasurable engagement, whereas low PA is characterized by sadness and lethargy. (Clark & Tellegen, 1988)

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19 Deluga examined a type of social exchange relationship, in contrast to the economic exchange simulated in Kollock's experiment.

Positive mood,[20] on the other hand, refers to how we feel at a particular time. It is a general "affective coloring for day to day events" while at work (George & Brief, 1992). PA is probably an antecedent of positive mood.

Are trusters in a better mood? The literature is unclear. Gurtman (1992) found that trust did not correlate with positive affect (which, from above, is an antecedent of good moods). However, Mitchell (1990) found that without trust, cooperation and sharing (components of social interaction) were less. Conceivably, the opposite may be true as well. Gurtman (1992) also found that high trusters less often reported problems with being socially avoidant. Social engagement or interaction and positive moods correlate (Watson, 1988a, in George & Brief, 1992, p. 317). Trusters may have a higher level of social engagement, and hence, might more often be in a better mood.

Differences in mood have a big impact on how people think, believe and behave (George & Brief, 1992). Specifically, people in positive moods are more creative because they tend to make more connections and integrations of divergent stimulus materials, use broader categories and see more inter-relatedness among stimuli. (Isen, Daubman & Nowicki, 1987, in George & Brief, 1992). Let's see why this may be so.

Tucker and Williamson (1984, in George & Brief, 1992, p. 315) suggest that positive and negative moods involve different hemispheres of the brain. In the new-brain, or neocortex, the right pre-frontal lobe (for right-handed people) appears to be responsible for negative emotions like bad moods, anger and sadness. The left lobe appears to have a role in attenuating the right lobe, and is also, interestingly, the center for speech processing (Goleman, 1995, p. 26 and p. 77) (in right-handed people).

The amygdala (and the limbic system in general -- the older, reptilian brain that some neurophysiologists believe evolved first) is also involved with negative emotions, though only those of the strongest, most impulsive sort (i.e., rage). When the amygdala (the center for the "fight or flight" response) perceives a threat, it activates the body and commandeers neocortical resources and impairs (or hijacks) higher-order brain functions. Goleman explains this is what happens when people get in a rage, and later report they "just couldn't think straight."

However, even at lower levels of anxiety, worry, fear or sadness (i.e., the neocortex right half is active -- that is, we're in a bad mood), our thinking can be impaired. Goleman refers to the resulting thought patterns, which take up mental resources, as "neural static".

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20 Positive mood is distinct from a similar construct, job satisfaction (which George and Brief argue is a construct more cognitive in nature than positive mood and denotes a feeling about work rather than a feeling at work). (George and Brief, 1992)

We experience happiness and an associated increase in energy, enthusiasm and "quieting of worrisome thought" when the left side regulates the right side. "Good moods, while they last, enhance the ability to think flexibly and with more complexity, thus making it easier to find solutions to problems... (p. 85)."

Laughter can lead to more creative thinking:

> The intellectual benefits of a good laugh are most striking when it comes to solving a problem that demands a creative solution. One study found that people who had just watched a video of television bloopers where better at solving a puzzle long used by psychologists to test creative thinking. (Goleman, 1995)

At the extreme, people can sometimes get into a very positive, intrinsically rewarding mental state that Mihaly Csikszentmihalyi (1990, in Goleman, 1995) calls "flow" (technically, "hypomania"). It is characterized by minimal levels of cortical activity altogether and the near absence of neural static. The "flow" state allows a person to pay complete attention to task and paves the way for mastery of skill, learning, and creative activities (i.e., composing a musical score).

Individuals in better moods, therefore, are more individually creative. Does this generalize to the group?

As it turns out, probably yes. One interesting finding is that positive moods 'foster or facilitate' helping behaviors (George & Brief, 1992, p. 316). People in positive moods are more likely to be attracted to others. Positive mood leads to "more integrative solutions being reached and more constructive and cooperative bargaining" (Carnevale & Isen, 1986, in George & Brief, 1992). So, to the extent being individually creative, attracted to others, helping others and bargaining cooperatively add up to or promote in-group creativity (as seems likely), then good moods lead to more in-group creativity.

Distrust lowers creativity

People who distrust others either perceive incompetence, dishonesty or threat (Rotter, 1967). When people judge others' competence to be low, they sometimes enter into exchanges of negative socioemotional behavior, which can lead to either anger or resignation/depression (Ridgeway & Johnson, 1990, p. 1197), both of which lead to neural-static. As described above, threat activates either the limbic system or the right pre-frontal lobe, each with the same effect -- neural static. Neural static impairs higher order functioning, including creativity.

Furthermore, since people store and retrieve memories using an emotional tagging system (Goleman, 1995, p. 19), distrusters will experience less access to ideas and memories with positive emotional tags (than higher trusters will), hence possibly experiencing less creativity.

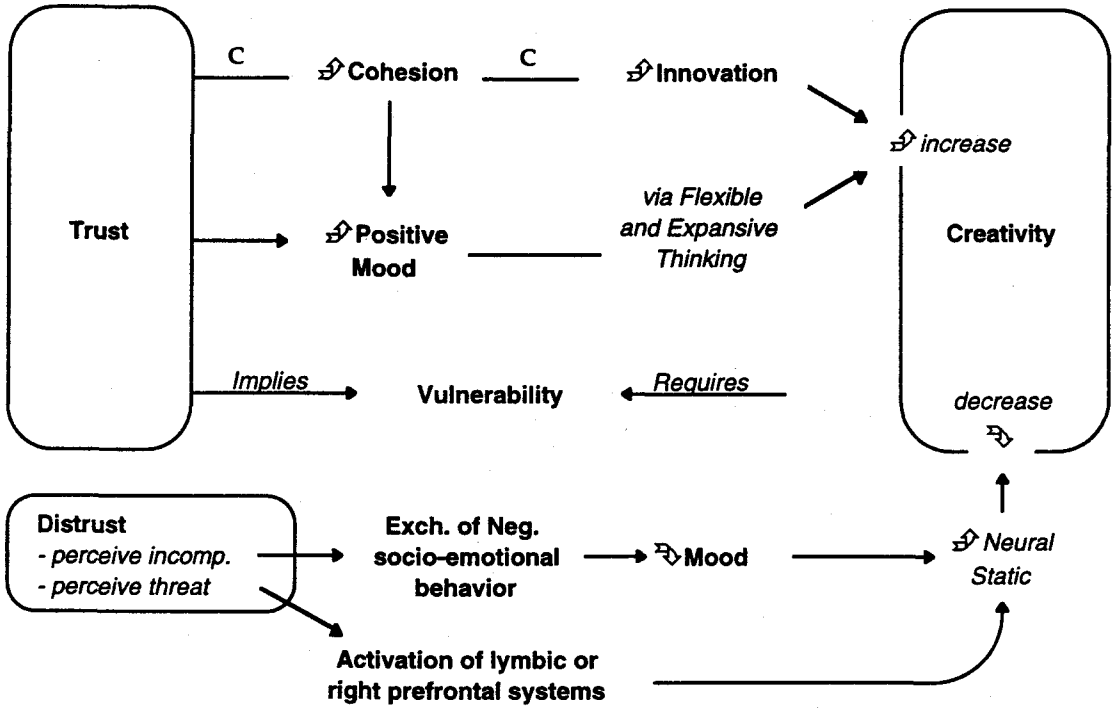
Therefore, when people distrust, they ought to be less creative. By implication, trusters ought to be more creative more of the time.

Creativity is an example of a trusting act

The fourth argument follows from logic. From Zand's (1972, in Kreitner & Kinicki, 1992) definition, trust requires vulnerability, but in-group creativity involves laying out ideas which most of the group does not hold. Following the notion people resist to change (at least sometimes) because new ideas are threatening, many if not all creative ideas have the potential to threaten other group members. However, threatening other members with creative ideas will open the creative person to ridicule, disagreement and sanction (Ridgeway & Johnson, 1990). Hence, in-group creativity involves doing something that could lead to group sanction. Creativity is an example of a trusting act.

Exhibit 3 illustrates and summarizes these arguments.

Exhibit 3



Trust and creativity

Trust correlates with cohesion, positive affect and the ability to engage socially, all of which are antecedents of good moods. Trust is related to good mood directly, and a good mood promotes creativity because it allows access to flexible and expansive thinking. Cohesion is positively correlated with innovation, and increased innovation leads to increased creativity. Distrust tends to block creativity. Compared to distrusters, trusters are more creative. Finally, trust implies vulnerability, while creativity in a group setting requires vulnerability. My conclusion is that trust leads to creativity.

INCREASED TRUST LEADS TO INCREASED COMMUNICATION

The process of communication

Bowditch and Buono (1985, in Kreitner & Kinicki, 1992, p. 81) defined communication as "the exchange of information between a sender and a receiver, and the inference (perception of meaning) between the individuals involved." Team members communicate by encoding messages, sending them through a medium, decoding them and developing meaning from them. Communication involves a feedback loop (or many, in a group situation).

Communication quality

People communicate well when the receiver constructs the same meaning as the sender originally encoded. Events can disrupt the process at any of the steps mentioned. People can improve communication if they communicate 1) more freely (allowing a flexible and fluid feedback mechanism), 2) more openly, 3) disclose more details, 4) listen more attentively or through some other means interpret the message more accurately or 5) in any other way reduce noise or mitigate the effects of noise on the communication process.

Trust leads to better communication

From our previous discussion, trust is correlated with cohesion and positive mood states. Members of groups with high levels of cohesiveness communicate "more frequently and more positively than members of low cohesion groups" (Owen, 1985, in Kreitner & Kinicki, 1992, p. 409). On the other hand, positive mood is associated with social engagement or interactions (Watson, 1988a, in George & Brief, 1992), with easier access to memories stored with a more positive affective tone, and with helping behaviors (George & Brief, 1992). These findings support the notion that positive moods lead to more open and free communication.

Positive moods probably facilitate listening as well. It is reasonable to suggest that better moods help a listener to make allowances for communication errors (for example, an unfortunate choice of words) because such errors are less likely to activate the limbic system while the left prefrontal circuitry is actively inhibiting negative emotions.

Trusters tend to disclose more, though research has shown that the number of people involved has a strong effect as well, as subjects were found more willing to disclose intimate information in a dyad than in a triad (Taylor, Desoto & Lieb, 1979).

People who are more assertive communicate more clearly. We know that because it is one of the main goals of assertiveness training. Sociability obviously aids communication generally, though sociability is not strictly required in new product development task team settings. High trusters had fewer self-reported problems with assertiveness, sociability (Gurtman, 1992). Hence, I expect trusters to communicate more clearly and more often as a result.

Burgoon (1991) found that touching conveyed (to third party observers) more immediacy, receptivity, trust, affection and informality than the absence of touching did. A combination of postural openness, relaxation and proximity also sent a powerful message of composure, similarity and affection and trust (p. 254). Furthermore, Kleck (in Knapp, 1978, p. 128) found that when people thought others were warm, they chose closer distances than when people thought others were unfriendly. Close friends (especially females) tend to sit closer than those who are not friends (Knapp, 1978). Trusters send relational messages communicating similarity, attraction and trust using non-verbal behaviors, including proximity and various forms of touch .

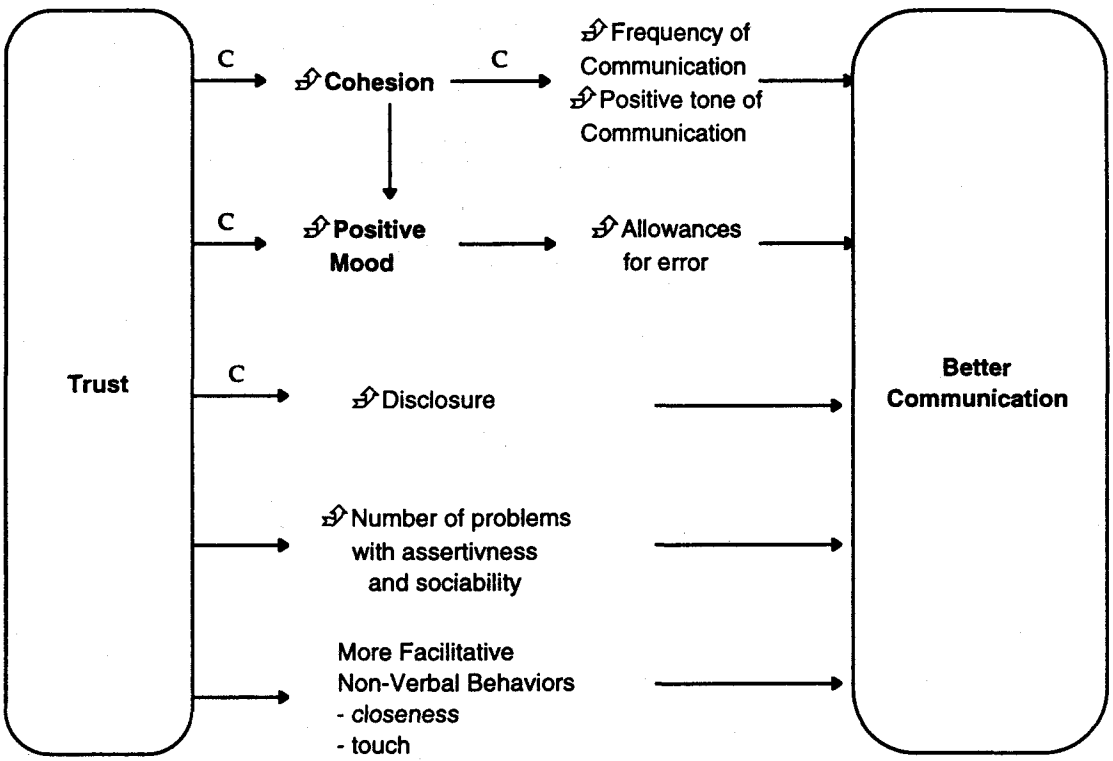
Most people would agree touch communicates volumes. Some forms of touch, though, constitute violations of relationship-based expectations, and so the people involved may experience more "noise" associated with resolving the situation. People undoubtedly vary in their admittance of touch. Someone who jumps at the slightest touch may not receive much information from such a communication. Depending on personal history with touch, a target may interpret all touch as aggressive behavior, and this mechanism may interfere with trust-building, regardless of the subject's general beliefs regarding people's trustworthiness.

Hence, increased proximity probably mitigates the noise associated with the "media" element of the communication process. For some, touch will have the same effect, but for others, touch will increase noise. Generally, we can expect trusters to increase proximity and touch and therefore to transmit more information and experience less noise.

Summary

Exhibit 4 summarizes these arguments.

Exhibit 4



Trust and communication

To summarize, trust leads to cohesion, which leads to more frequent and positive communication, and to positive mood states, which foster openness and freedom of communication. Positive mood may help communicators make allowances for poor communication. Trust leads directly to more disclosure. Trusters have fewer problems being assertive and social, and trusters use more facilitative non-verbal behaviors, including using closer interpersonal distances and touch, all of which enhance communication.

Hypothesis

On the basis of on the previous discussion as it applies to individuals in a work setting, the following hypotheses are presented:

H1: a measure of trust-trait is correlated with a measure of communication
H2: a measure of trust-trait is correlated with a measure of creativity
H3: a measure of trust-trait is correlated with a measure of empathy
H4: a measure of trust-trait is correlated with a measure of positive affect

This work focuses only on the above hypotheses. However, based on the previous discussion as it may apply to dyadic trust and to an aggregate measure of the general level of trust among members of larger work groups, or teams, the following hypotheses are presented as interesting and as suggested topics for future research:

H5: dyadic trust is correlated with strength of relationship or intimacy
H6: group-level trust is correlated with group cohesiveness
H7: group-level trust is correlated with quality and quantity of in-group communications
H8: group-level trust is correlated with group positive affect
H9: group-level trust is correlated with group openness to creative expression

Experiment

Summary

To test the hypotheses, a survey (self-report questionnaire) was administered to Engineers (and others working on new product development task teams) in the medical device industry. Scores and correlation coefficients, r,[21] were obtained for five constructs (trust, communication, creativity, emotional empathy and positive affect). The correlations were tested for significance.[22] No significant correlations were found among these variables, and no evidence was found to support the hypotheses.

Definitions

The five constructs were defined. Interpersonal trust was defined as "an expectancy held by an individual or group that the word, promise, verbal or written statement of another individual or group can be relied upon" (Rotter, 1967). Communication was defined as the self-reported tendency to communicate frequently, informally and clearly with teammates. Creativity was thought to involve several components -- ideational fluency, flexibility, originality and remote association. Emotional empathy was defined as the ability to experience the same emotions as felt by an observed other. Positive affect (PA) was defined as the extent to which a person feels enthusiastic, active, and alert.

Measures

Personality traits (or "attitudes") have three components: cognitive, emotional and behavioral (Scott, 1980). There are three methods of examining these components of personality traits: direct observation, simulation that requires subjects to use the associated behavior, and survey (either interview or questionnaire). (Cook & Wall, 1980).

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21 r is the "Pearson product moment coefficient of correlation" (Sincich, 1990).

22 ...using simple linear regression analysis (Sincich, 1990) as aided by Microsoft Excel, version 4.0 (US), © Microsoft Corporation.

All three methods have been used and found valid, and each has advantages and drawbacks. A survey method was chosen for this study because 1) adequate and pre-validated measures were available,[23] 2) the survey method was the least expensive and fastest method, and 3) survey methods were least disruptive (hence most acceptable) to people in the sample.

Procedure

SCALE SELECTION

Scales were sought which had the following properties: they were designed to measure the constructs defined above (the operationalization of the construct measured matched the definition used here), they appeared from the literature well accepted and in current use, they were shown to have good reliability and validity[24] , and they were appropriate to adult professionals. Instruments were selected which could be self-administered (possibly at home), that were easy to complete (Likert-type if possible) and were short.

To measure *trust*, I chose Rotter's (1967) Interpersonal Trust Scale (ITS). The version used here excluded filler items. The ITS has been a commonly used measure and is cited widely. It is known to measure two factors, conceived of as *trust in government and social institutions* and *trust in familiar others*. At least one study suggests that a recorded decline in trust among members of the public over the past few decades is primarily a decline in trust of government and social institutions rather than a decline in trust of familiar others.

Paper and pencil measures of creativity that meet all the criteria above are hard to find, and interpretation of the more involved measures is generally difficult (e.g., some require scoring of subject's drawings or word associations) and vulnerable to the subjectivity of the administrator. Accordingly, to measure *creativity*, I chose the Khatena-Torrance Creative Perception Inventory (KTCPI). Composed of two parts, I used "What Kind of Person Are You" (WKOPAY) (Khatena & Torrance, 1970) only, designed to provide an overall creativity index. I did not use the other part (Something About Myself - SAM). SAM is designed primarily as a screening instrument. (Rockenstein in Keyser & Sweetland, 1992).

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23 ...except for the construct of "communication".

24 For a short discussion of reliability and validity , see Appendix E. See also Fink & Kosecoff, 1985.

I could not (within project time frame) find an adequate scale to measure the communication construct desired: "self-reported tendency to communicate frequently, informally and clearly with teammates." So, I constructed a scale of four completely original and altogether untested items. The scale, therefore, is original and unvalidated. *The lack of reliability and validity testing for this scale is a serious drawback of this research.* However, I structured these four questions with the following principles in mind: avoid emotionally charged and ambiguous words, keep the reading level low, adhere to a 7 item Likert-type format, key half negatively, try to illicit images of the work setting, try to facilitate access to feelings and impressions rather than cognitions and allow for plausibility of all allowed responses (i.e., Strongly Agree or Strongly Disagree). The scale is scored identically to the ITS: the subject's responses ranging from 1 (Strongly Disagree on positively keyed items) to 7 (Strongly Agree on positively keyed items). Reverse scoring on negatively keyed items. The range of possible scores is 4 to 28; because of the very low number of items, unless the subject answers all items, the measurement was discarded. For purposes of this study, the scale was identified as CS-4 (Communication Scale -- 4 items), which is consistent with the naming of, RD-16, a sixteen-item measure of socially desirable responding (introduced below).

Empathy has been operationalized in primarily two ways. The earlier definition is as a cognitive role-taking ability -- essentially, the ability to put oneself in the shoes of another (the target). This *cognitive empathy* was measured by assessing the accuracy with which the subject could predict the target's thoughts and emotions. A more recent version, *emotional empathy*, is defined as the ability to experience the target other's emotions (Mehrabian & Epstein, 1972). It is sometimes measured by monitoring the subject's physiological manifestations of emotional experience (e.g., perspiration, heart rate) while the subject views a target's emotional signals -- for example, on video tape. Similarity of subject and target's physiological responses indicates empathy. However, for this study, I selected Mehrabian and Epstein's self-report scale of empathic tendency, also called the Balanced Emotional Empathy Scale (here, BEES).

To measure *positive affect*, I selected the Positive and Negative Affect Scale (PANAS) (Watson, Clark & Tellegen, 1988). The entire scale contains 20 items, but since Negative Affect is not being measured, only 10 scored items are required. This scale presents a list of 10 adjectives (examples are: interested, excited) and asks the respondent to "indicate to what extent you have felt this way during the past few months." The ratings range from 1) "very slightly or not at all" to 5) "extremely". The version here includes the positive affect scale

only.[25] The PANAS allows the researcher to select an appropriate set of "time instructions". I used the "past few months" time instructions. Shorter-duration time instructions presented the possibility of measuring situationally enhanced positive affect (or, perhaps, positive mood), although the supporting literature does not mention this possibility. As task team duration (in the medical device industry) is usually on the order of months rather than weeks, a time instruction of "past few months" was logical.

To control for desirable responding, a sixth scale to measure socially desirable responding, or SDR, was included. The 16 item scale is called the Responding Desirably on Attitudes and Opinions, or the RD-16 (Schuessler, Hittle & Cardascia, 1978. See also Paulhus, 1991 in Robinson, et al, 1991).

The six scales and additional questions to gather demographics made up the survey questionnaire. The six scales are summarized in Exhibit 5: Summary of Scales and published measures of reliability and validity are summarized in Exhibit 6: Summary of Scales, Reliability and Validity. Note all scales have adequate measures of reliability and validity, except for CS-4, which is untested.

Exhibit 5: Summary of Scales

Scale	Construct	Items	Type	Intervals	Published
ITS[26]	Trust	25	Likert	5	Rotter, 1967
CS-4	Communication	4	Likert	7	NA
WKOPAY	Creativity	50	Forced Choice	2	Khatena & Torrance, 1976
BEES	Empathy	33	Likert	9	Mehrabian & Epstein, 1972 Mehrabian, 1996
PANAS	Positive Affect	14 (4 Filler)	Likert	5	Watson, Clark & Tellegen, 1988
RD-16	SDR	16	Forced Choice	2	Schuessler, Hittle & Cardascia, 1978
Total		*142*			

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25 On the advise of one of the authors, 4 filler items were included to discourage response bias in the form of a response set. (Personal communication with Dr. David Watson, 15 April, 1996).

26 Fifteen filler items, often included to disguise the purpose of the ITS scale, were omitted in this study.

Exhibit 6: Summary of Scales, Reliability and Validity

Scale	Stability	Homo-geneity	Internal Consistency	Demonstrated Validity
ITS	n=42, r=.68, 3 months	S.H.	r=.76, p<.001[27]	Good Content and Construct validity[28]
CR-4	-	-	-	-
WKOPAY	n varies, r≥ .71, (p< .01) same day to 6 weeks	S.H. (odd-even)	r=.98[29]	Content Validity - Q-Sort Method. Content validity established in 4 studies.
BEES			n=unknown, α=.87	Coorelates well with EETS (Mehrabian & Epstein, 1972)
PANAS	n=101, r=.58, 2 months	C.A.	n≥586, α≥.86	Good Content[30] and Construct validity[31]
RD-16		S.H. r>.60	weak inter-item correlation	Good observed corr. w/ other scales (i.e., Marlowe-Crowne)

Notes: S.H.=split-half reliability, C.A.=Cronbach's coefficient alpha, [-] = untested.

SURVEY CONSTRUCTION

A cover letter was composed to 1) provide informed consent, 2) increase response rate, 3) encourage the subject to complete the questionnaire in a relaxed and informal setting, 4) to provide instructions for returning the form and 5) to show the researcher's affiliation with Oregon State University. The cover letter communicated the survey was anonymous

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27 ...split-half reliability, corrected by the Spearman-Brown Prophesy Formula (Rotter, 1967).

28 The ITS has significant intercorrelations with sociometric trust, sociometric trustworthiness and self-rating of trust, but not with 6 other measures -- hence good content and discriminant validity. (Rotter, 1967)

29 ...split-half reliability, corrected by the Spearman-Brown Prophesy Formula (Rockenstein, in Keyser & Sweetland, 1992).

30 "Item validity" was tested using "factor analysis" and the factored ratings on the 20 PANAS items as "communality estimates". According to the authors, "All of the descriptors have strong primary loadings (.50 and above) on the appropriate factor, and the secondary loadings are all acceptably low...items are good markers of their corresponding factors." (Watson, Clark & Tellegen, 1988)

31 "Scale validity" was tested using "factor analysis" and 60 Zevon and Tellegen (Watson, Clark & Tellegen, 1988, p. 1066) mood descriptors as "communality estimates". n=589, r=.92.

(information replicated on the form itself). While the envelopes were, of necessity, addressed, the forms were not numbered, so a suspicious subject would not find evidence of tracability. Each outside envelope contained a self-addressed return envelope to increase response rate.

Two more letters (a follow-up letter and a "thank-you" letter) were also prepared and distributed to the entire sample shortly after the survey was distributed, to improve response rate.

Appendix B presents the cover letter, part of the questionnaire (this researcher cannot publish some survey items), the follow-up letter and the thank-you letter.

Appendix F presents the correspondance between the researcher and the authors of each of the five measures (including permissions), the correspondence between the researcher and the management of the company where the sample was studied (including permissions), and the letter, obtained through Oregon State University's IRB process, granting permission to proceed with the study.

ABOUT THE SAMPLE

The sample consisted of permanent employees at a manufacturer of medical devices (catheters and related devices) located in the San Francisco Bay Area. The sample's frame was drawn from a list provided by the Human Resources department. Only permanent employees with at least three months continuous tenure were included. Included were positions likely to have worked on NPD Task Teams: R&D, Equipment, Manufacturing, Industrial and Quality Engineers, Production Supervisors, Production Planner/Buyers, R&D Technicians and certain managers. Culled from the list were employees, based on their position and known history, that were not likely to have worked on New Product Development Task Teams (i.e., marketing was included while salespersons were not). The researcher, a consultant for the company at the time, was not included.

SURVEY DELIVERY AND RECOVERY

The survey was administered to a frame of 112 employees on or about July 15, 1996. Of these, 15 (13.4%) had been employed with the company less than four months. To determine if those 15 had enough experience in the medical device industry, these subjects were given the additional two-item qualifying survey (see also Appendix B). The survey and follow up letters

were deployed through interoffice mail or delivered to employees desks or in person (in that order of researcher preference).

At one-week the follow-up letter was deployed, and at two-weeks the thank you letter was deployed.

Responses were accepted until August 8th, 1996 (24 full days). As of September 7th, 1996, 45 responses were received, but one of the 45 responses had arrived after the deadline of August 8th and was discarded. Of the 44 remaining, three responses came back with the two-item qualifying survey, properly filled out.[32] One of these three was discarded because the respondent reported less than six months medical device industry experience, leaving 43 responses. All 43 remaining responses appeared seriously completed. One respondent failed to complete the WKOPAY (missed a page) and the associated creativity score was omitted. One respondent failed to fill out the PANAS completely (three items left blank) and the associated PA score was omitted.

Hence, n=43, except for WKOPAY and PANAS, where n=42, for an overall response rate of 38.4%, which was higher than the researcher had expected.

Demographic statistics for both the frame and the sample are shown in Exhibit 7: Summary of Population Statistics of Frame and Sample.

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32 Since not all 15 of the qualifying surveys are accounted for, the possibility exists that some respondents had less than four months industry experience and their responses were nevertheless included in the survey results.

Exhibit 7: Summary of Population Statistics of Frame and Sample

Statistic	Frame	Sample	Statistic	Frame	Sample
n	112	43	Marital Status		
			Single #/%	na	10/23%
Income Level ($1,000)			Married #/%	na	26/60%
Range	22-105	na	Divorced #/%	na	4/9%
Mean	35	na	Widowed #/%	na	0/0%
SD	10	na	Did Not State #/%	-	3/7%
Gender			Years of Education		%
Male	66%	53%	Range	na	10-18
Female	34%	40%	Mean	na	14
Did Not State #/%	-	3/7%	SD	na	2
			Did Not State #/%	-	3/7%
Age			Tenure w/ company (yrs.)		
Range	24-56	24-54	Range	<1-12	<1-9
Mean	35.3	35.3	Mean	na	3
SD	6.7	6.8	SD	na	2.5
Did Not State #/%	-	10/23%	Did Not State #/%	-	8/19%

Data Analysis

Appendix C presents Exhibit C1 showing respondent scores. Appendix E presents Exhibits E1 through E15 showing the scattergram and the correlation analysis of each pair of variables. In this section, Exhibit 8 presents the means and standard deviation of all measures, while Exhibit 9 presents the table of intercorrelations.

Exhibit 8: Means and Standard Deviations of Measures

Measure	Min	Max	Mean	Std Dev	n
Interpersonal Trust	54	106	82.8	10.9	43
Communication	6	18	11.8	3.0	43
Creativity	17	40	27.0	5.5	42
Emotional Empathy	-3	84	42.4	23.0	43
Positive Affect	24	50	36.9	5.4	42
Socially Desirable Responding	10	16	13.8	1.7	43

Exhibit 8: Intercorrelations Among Measures

	Trust	Comm.	Creat.	Empathy	Pos. Aff.	SDR
Trust						
Communication	-.13					
Creativity	-.08	-.41				
Emotional Empathy	-.19	-.10	.08			
Positive Affect	-.01	.03	-.03	.16		
SDR	-.35	-.11	.02	.00	.32	

Sample Pearson product moment Coefficient of Correlation, r, is shown.
Significant correlations (alpha = .050, r-crit = .257) are boxed.
Other correlations are not significant.

Results

This experiment failed to show evidence of any of the hypothesized correlations of trust with communication, creativity, emotional empathy and positive affect. Moreover, a significant correlation between creativity and communication is not in the direction expected. The other two statistically significant correlations are not strong enough to interpret confidently (at alpha = .010, r-critical = .358). Finally, the tendency of r's in the first column to tend toward zero or negative make it seem unlikely surveying the employees of a second company would yield much useful information.

There are three broad explanations I can think of: 1) the argument leading to the hypotheses was poorly constructed, 2) the hypotheses do not follow from the argument, or 3) the method of testing was inadequate.

Some potential sources of error occur to me. First, by studying employees of the company at which I worked, despite precautions, including avoiding discussion of my research, I may have introduced bias by being on site. The high response rate tends to support this explanation. Second, NPD Task Team members may not reflect the makeup of the general population, and arguments based on research on the general population (or, for example, mineworkers or blue collar workers) may not hold for this group. For example, the "psychological" nature of these questions may have aroused suspicion among mostly engineering professionals - high SDR scores tend to agree with this supposition. Finally, one type of validity I did not find reported was whether or not a given survey questionnaire was as valid administered alone as when administered as part of a battery of similar surveys. Since test-retest validity is generally reported, an alternative administration would be to code the surveys by respondent, then give the ITS one week, give the BEES another week, and so on. (However, this technique would destroy the anonymity of the research).

Some aspects of these results are not surprising. The instrument to measure communication was unvalidated, so any results would are suspect. Also, creativity is probably less clearly understood here than are trust, empathy and positive affect. The particular aspects of creativity mentioned in my argument may not be the particular aspects of creativity measured by WKOPAY. Indeed, for purposes of strategic advantage in business, a metric of *group* creativity would be superior, I think, to the metrics of individual creativity I found.

However given the specificity of the trust and emotional empathy scales, and the strength of the argument presented - especially the linkage of both to early childhood development - the lack of statistical evidence associating trust and empathy is particularly confusing and frustrating.

Implications

This research attempted to show that managers could coach employees and increase trait interpersonal trust (or at least differentially encourage trusting relationships), and in so doing, increase empathy, positive affect, creativity and communication. By increasing communication and creativity, some companies (including medical device companies) could garner strategic advantage that would be difficult to replicate.

Unfortunately, this research does not strongly recommend the above course of action. The techniques of coaching for trust are developed mainly for counseling at risk youth, while in the corporate setting are largely unproved. This research failed to support that trusters will be more communicative or more creative, or that communication and creativity cannot be more efficiently achieved through more direct means. Finally, while creativity is important in the medical device industry, it is not the only source of strategic advantage, and creativity might still be a relatively weak advantage compared with more conventional strategic advantages such as market position, supplier relationships and outstanding product quality.

However, there are compelling new questions raised here. Is there merit in studying networks where group members are nodes and a measure of dyadic interpersonal trust forms the links? In such a "trust net" would three or four high trusters always or usually form the familiar structure known as a "core team"? Would such a group unduly influence group norms?

Are the highest performing teams made up largely of high trusters? Small companies and "skunk works" and neighborhoods in crisis seem to "pull together". Why? Are there different kinds of "pulling together", and can the process be linked to changes in levels of trust, empathy and type of communication? Could autonomous agents (real or virtual) benefit from an understanding of other agent's trustworthiness, and if so, under what circumstances would a group of such agents interact to the aggregate good of the group?

On a more "down to earth" level, this thesis presents a series of suggestions for future research. First, the efficacy of coaching for trust among the adult population and in the corporate environment specifically needs to be better understood. In part to complement the previously suggested research into trust-nets, good measures of group-level creativity need to be developed. Further study focusing only on the hypothesized linkage between interpersonal trust and emotional empathy is indicated, especially given the increased incidence of everyday violence in our society, and the apparent increased acceptance of violent content in our popular culture.

Summary

This thorough, multi-faceted view of trust will perhaps be helpful to some professional managers and academics. In this study, a detailed exploration was undertaken to better understand the relationships among several psychological constructs including interpersonal trust, communication, creativity, emotional empathy, positive affect. The relationship between early childhood experiences, neurological development and these constructs was highlighted. The study of brain function, neurological development and emotional intelligence is in its infancy, but is being accelerated by recent technical advances. Savvy handling one's own emotions and the emotions of others can account for success or failure in one's public and personal life.

The study of interpersonal trust was motivated to some measure by the main thesis - that high levels of interpersonal trust among members of certain kinds of organizations can represent a sustainable strategic advantage for those organizations.

Hypotheses regarding relationships among trust and the other constructs were tested. This study included the development of a sociometric survey research questionnaire to test these hypotheses. However, the expected correlations were not found, and several explanations were offered.

Implications and directions for future research were discussed.

References

Badawy, M. K. (1988). How to prevent creativity mismanagement. IEEE Engineering Management Review, 16, 63-70.

Begley, S., (1996, February). Your child's brain. Newsweek, pp. 55-61.

Brown, W. B., & Karagozoglu, N. (1989). A systems model of technological innovation. IEEE Transactions on Engineering Management, 36, 11-16.

Burgoon, J. K. (1991). Relational message interpretations of touch, conversational distance, and posture. Journal of Nonverbal Behavior, 15, 233-259.

Cook, J., & Wall, T. (1980). New work attitude measures of trust, organizational commitment and personal need non-fulfillment. Journal of Occupational Psychology, 53, 39-52.

Deluga, R. J. (1994). Supervisor trust building, leader-member exchange and organizational citizenship behavior. Journal of Occupational and Organizational Psychology, 67, 315-326.

Driskell, J. E., Olmstead, B., & Salas, E. (1993). Task cues, dominance cues, and influence in task groups. Journal of Applied Psychology, 78, 51-61.

Fink, A., & Kosecoff, J. (1985). How to conduct surveys: A step-by-step guide. London: Sage.

George, J. M., & Brief, A. P. (1992). Feeling good-doing good: A conceptual analysis of the mood at work-organizational spontaneity relationship. Psychological Bulletin, 112, 310-329.

Givens, D. B. (1978). The nonverbal basis of attraction: Flirtation, courtship and seduction. Psychiatry, 41, 346-359.

Goleman, D. (1995). Emotional Intelligence. New York: Bantam.

Gurtman, M. B. (1992). Trust, distrust, and interpersonal problems: A circumplex analysis. Journal of Personality and Social Psychology, 62, 989-1002.

Hardwig, J. (1991). The role of trust in knowledge. Journal of Philosophy, 88, 693-708.

Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitates creative problem solving. Journal of Personality and Social Psychology, 52, 1122-1131.

Keller, R. T. (1986). Predictors of the performance of project groups in R & D organizations. Academy of Management Journal, 29, 715-726.

Keyser, D. J., & Sweetland, R. C. (Eds.) (1992). Test Critiques. Austin, TX: Pro-Ed.

Knapp, M. L. (1978). Nonverbal communication in human interaction (2nd ed.). New York: Holt, Rinehart and Winston.

Kollock, P. (1994). The emergence of exchange structures: An experimental study of uncertainty, commitment, and trust. American Journal of Sociology, 100, 313-345.

Kreitner, R. & Kinicki, A. (1992). Organizational Behavior (2nd ed.). Homewood, IL: Irwin.

Manz, C. C., & Sims, H. P., Jr. (1986). The potential for 'groupthink' in autonomous work groups. Human Relations, 35, 773-784.

Mehrabian, A. & Epstein, N. (1972). A measure of emotional empathy. Journal of Personality, 40, 525-543.

Mitchell, C. E. (1990). Development or restoration of trust in interpersonal relationships during adolescence and beyond. Adolescence, 25, 847-854.

Paulhus, D. L. Measurement and control of response bias, in Robinson, John P., Shaver, Phillip R. and Wrightsman, Lawrence S., (Eds) (1991). Measures of Personality and Social Psychological Attitudes. San Diego, CA: Academic Press.

Porter, M. E. (1985). Competitive advantage: Creating and sustaining superior performance. New York: The Free Press.

Ratajczak, Z., & Jagoda, I. (1984). Trust and effectiveness and means of communication in a task group. Przeglad-Psychologiczny, 27, 601-615. (From Psychological Abstracts, 1986, Vol. 73, Abs. No. 21925)

Rotter, J. B. (1967). A new scale for the measurement of interpersonal trust. Journal of Personality, 35, 651-665.

Rotter, J. B. (1971). Generalized expectancies for interpersonal trust. American Psychologist, 26, 443-452.

Rotter, J. B. (1980). Interpersonal trust, trustworthiness, and gullibility. American Psychologist, 35, 1-7.

Sabatelli, R., Buck, R. & Dreyer, A. (1983). Locus of control, interpersonal trust, and nonverbal communication accuracy. Journal of Personality and Social Psychology, 44, 399-409. (From Psychological Abstracts, 1983, Vol. 70, Abs. No. 05637)

Schill, T., Toves, C., & Ramanaiah, N. (1980). Interpersonal trust and coping with stress. Psychological Reports, 47, p. 1192.

Schuessler, K., Hittle, D., & Cardascia, J. (1978). Measuring responding desirably with attitude-opinion items. Social Psychology, 41, 224-35.

Scott, C. L. (1980). Interpersonal trust: A comparison of attitudinal and situational factors. Human Relations, 33, 805-812.

Sincich, T. (1990). Statistics by example (4th ed.). San Francisco: Dellen.

Taylor, R. B.; Desoto, C. B.; & Lieb, R. (1979). Sharing secrets: Disclosure and discretion in dyads and triads. Journal of Personality and Social Psychology, 37, 1196-1203.

Torrance, E. P. & Khatena, J. (1970). What kind of person are you?: A brief screening device for identifying creatively gifted adolescents and adults. Gifted Child Quarterly, 14, 71-75.

Vaught, C. & Wiehagen, W. J. (1991). Escape from a mine fire: Emergent perspective and work group behavior. Journal of Applied Behavioral Science, 27, 452-474.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology, 54, 1063-1070.

Wilson Learning Corporation. (1991). Team decision making: participant guide. Eden Prairie, MN: Wilson Learning.

Wrightsman, L. S. (1991). Interpersonal trust and attitudes toward human nature. In Robinson, J. P., Shaver, P. R., & Wrightsman, L. S. (Eds.) (1991). Measures of personality and social psychological attitudes. San Diego, CA: Academic Press.

Bibliography

Booth, W. C., Colomb, G. G. & Williams, J. M. (1995). The craft of research. Chicago: The University of Chicago Press.

Davies, P. (Ed.) (1976). The American heritage dictionary of the English language (paperback ed.). New York: Dell.

Fowler, F. J., Jr. (1988). Survey research methods (rev. ed.). London: Sage.

Gersick, C. J. (1988). Time and transition in work teams: Toward a new model of group development. Academy of Management Journal, 31, 9-41.

Hill, G. W. (1982). Group versus individual performance: Are N + 1 heads better than one? Psychological Bulletin, 91, 517-539.

Hoffman, L. R., Harburg, E., & Maier, N. R. F. (1962). Differences and disagreement as factors in creative group problem solving. Journal of Abnormal and Social Psychology, 64, 206-214.

Hoffman, R. L., & Maier, N. R. F. (1961). Quality and acceptance of problem solutions by members of homogeneous and heterogeneous groups. Journal of Abnormal and Social Psychology, 62, 401-407.

Maier, N. R. F., & Hoffman, L. R. (1960). Quality of first and second solutions in group problem solving. Journal of Applied Psychology, 44, 278-283.

Mawson, C. O. S., & Whiting, K. A. (Eds.) (1946). Roget's pocket thesaurus. New York: Pocket Books.

Michaelson, L. K., Watson, W. E., & Black, R. H. (1989). A realistic test of individual versus group consensus decision making. Journal of Applied Psychology, 74, 834-839.

Newman, A. E. (1991). Multifunctional equipment design teams. 1991 International Industrial Engineering Conference Proceedings, 253-261.

Nye, R. D. (1986). Three psychologies (3rd ed.). Monterey, CA: Brooks/Cole.

Paese, P. W., & Kinnaly, M. (1991). Effects of role assignment and verbal interaction on accuracy and overconfidence in interpersonal judgment. Journal of Applied Social Psychology, 21, 1418-1439.

Richardson, J. (1987). The magic of rapport. Cupertino, CA: Meta.

Rothenberg, A. (1979). The emerging goddess. Chicago: The University of Chicago Press.

Torrance, E. P. (1957). Group decision-making and disagreement. Social Forces, 35, 314-318.

Walton, R. E. (1985). From control to commitment in the workplace. Harvard Business Review, 63, 77-84.

Warr, P. B., Cook, J., & Wall, T. (1979). Scales for the measurement of some work attitudes and aspects of psychological well-being. Journal of Occupational Psychology, 52, 129-148.

Weisbord, M. R. (1987). Productive workplaces. San Francisco: Jossey-Bass.

Womack, J. P., Jones, D. T. & Roos, D. (1990). The machine that changed the world: The story of lean production. New York: HarperPerennial.

Ziller, R. C., Behringer, R. D., & Goodchilds, J. D. (1962). Group creativity under conditions of success or failure and variations in group stability. Journal of Applied Psychology, 46, 43-49.

Appendices

APPENDIX A

How Trusting Relationships Form

Antecedents of particular trusting relationships

TRUST CAN COME ABOUT THROUGH EDUCATION AND TRAINING

Trust, the ascription, is a belief. Trust, the act of making oneself vulnerable, is behavior. "Belief and behavior are interconnected, each influencing and providing justification for the other." (Becker, Geer, Hughes & Strauss, 1961; and Heise, 1979; both in Vaught & Wiehagen, 1991). Indeed, behavior entered into voluntarily, we can argue, is based on beliefs, though some of these beliefs are not consciously expressed in the moment, and some beliefs may simply be emotional images stored in our most ancient brains. Trust (that is, any given act of trusting) is a behavior based on beliefs.

We can influence this behavior by changing the underlying beliefs. Mitchell (1990) has demonstrated that trust can be taught, at least in adolescents, and she proposes a teaching method. Furthermore, behaviors leading others to trust us (or at least to feel better about us, a precursor to other's trust in ourselves) can be taught, and because trust is reciprocal in nature, such behavioral modification eventually leads to our trusting others more. A contrary argument, however, is that trust capacity develops at such an early age, and the process of re-wiring neuro-circuitry so difficult and demanding, that it can become an insurmountable task, especially after the teenage years (Begley, 1996; Mitchell, 1990; Goleman, 1995).

TRUST CAN ARISE SPONTANEOUSLY, SINCE PEOPLE NEED TO PREDICT OTHER'S BEHAVIOR.

Hardwig (1991) argues that most, if not all, modern knowledge is based on interpersonal trust, because the very process of research requires high levels of trust among colleagues. He sites a very large physics project that researched the life span of charm particles, which involved the collaboration of 99 scientists from around the globe. No one scientist could, by herself, assimilate the diversity of information required to the depth required to do the project

herself, hence this project could not be done without at least some level of interpersonal trust. Modern scientists must make claims based, in part, on evidence they do not personally understand. In the charm project, each person made a sub-claim that the other researchers on the team were competent, truthful and benevolent. If the scientists hold this opinion of most people, then the scientists meet Rotter's definition of generalized expectancy for trust. This example shows trust in the research community is required, and *because it is required* (though other factors may be present), *it arises.*

The requirement for trust extends to other professions. Kollock (1994) found that trust can develop between buyers and sellers in an exchange relationship, even when buyers and sellers know each other only by a letter designation and price/performance estimates over several simulated trades. Kollock found that buyer's commitment to a seller is more likely to develop if 1) buyer and sellers have different sets of information (such that the seller can sell "lemons"), 2) the information asymmetry leads to the buyer perceiving a risk (and hence increases the importance of seller reputation) and 3) repeated trades allow the seller to establish a reputation among the buyers. These conditions did not *always* lead to trust, but they made trust possible since buyers were motivated find a way to predict behavior and had an opportunity to act on that information.

A common theme here is *the need to predict another's behavior* (see also Kreitner & Kinicki, 1992, p. 408). The need to predict other's behavior is highlighted in a particularly dangerous setting, a coal mine. Vaught and Wiehagen (1991), while exploring the effects of the sociotechnical system on coal miners' ability to evacuate from a large mine fire, argued that:

> [Normal operation, characterized by high levels of danger, leads to a] need to predict what other [miners] are likely to do...[and this] forms their adaptive normative and valuative system...miners constrain themselves to behave [per] collective expectations...[including] the concept of the buddy. [S]ticking together is a 'sacred code'. (Lucas, 1969, in Vaught & Wiehagen, 1991)

In this particular sociotechnical system, actors consciously look for trustworthy partners, and explicitly and strongly sanction those that do not conform to expectations for predictability.

TRUST HAS AN OPPORTUNITY TO FORM IF THE TRUSTER CAN GATHER INFORMATION

For a particular trusting dyad to form, person A must make an ascription about person B's competence, honesty and benevolence. That means person A has to first gather evidence about person B.

People can assess competence cognitively, for example, noting the other has a professional degree, task-related experience or other special training. However, people also use proxies (which may rely on emotional assessments of the target) for information about a person's competence. Indeed, task cues (for example, a person's sex and race, where one sits in a meeting and other non-verbal behavior) are correlated with performance expectations (see Ridgeway & Johnson, 1990; Driskell, et al., 1993). These results suggest that people form estimates of competency based, in part, on task cues. Interestingly, dominance cues (e.g., finger pointing, loud speech) do not affect performance expectations.

It is interesting to recall that the Gurtman's circumplex model accurately predicted distrusters were associated with the dominance half of the Dominance/Submissive scale. People who use dominance cues may cause others to think simultaneously "he's a distruster" and "he's a poor performer", hence trust may be withheld for reasons of reciprocity and because the observer cannot make the ascription of competence. Finally, dominance cues may also provide information about malevolence -- they are, by definition, threatening.

So, a person can gather evidence about *competence* and *malevolence*, (if not benevolence). Yet how can a potential truster determine if a person is honest? The Symbolic Interaction Approach (see Vaught & Wiehagen, 1991) has three tenants:

1) People act on the basis of what they think encountered objects/situations mean.
2) The meanings of objects are defined socially.
3) Each person interprets and modifies meanings as they encounter new objects or situations.

An object can be intangible, for example, a reputation. Hence, reputation can lead to initial ascriptions of honesty, but those ascriptions are subject to alteration considering new events or changes in socially derived definition of the reputation-object in question.

There may also be individuating cues at work. The potential truster might, for example, detect non-verbal behavior if the other is lying at the moment (but, as noted in Knapp (1978, pp. 229-232) only about 50% of the time, or at chance level), yet it is unclear whether a single detection will inhibit subsequent ascriptions of general honesty. At this point, it seems unlikely that one could adequately assess another's honesty without long experience with that person.

RECIPROCITY

Finally, as hinted at before, trust involves reciprocol behavior, or exchange. Workplace relationships are reciprocal in nature (Deluga, 1994). Trust is no exception; when we think someone trusts us, we tend to trust that person in return (Lewis & Weigert in Kreitner & Kinicki, 1992, p. 405). This may be true because trusting others tends to lead to an increase in self confidence (Terrell & Barret, 1979) "There is a tendency to trust those who are self-disclosing." Interestingly, we can conclude that high trusters are more likely to trust, hence more likely to self-disclose. Trust and self-disclosure are likely to illicit trust and self-disclosure in return, especially from other high trusters. Conversely, distrusters are likely to meet each other with more of the same.

Trust Net

Accordingly, I theorize the existence of a "trust net" in at least some communities. High trusters preferentially engage one another, and the engagements are self-reinforcing. Trusters will have more "connections" with other trusters than with distrusters. Meanwhile, distrusters are unlikely to participate. Distrusters will have fewer connections than trusters. Furthermore, a parallel network of distrusters is unlikely to form. Distrusters are more likely to be disenfranchised, while high trusters are more likely to gain access to information (both in terms of quantity and quality, as well as level of intimacy), affiliation, empathy, positive affect and helping behaviors. Goleman (1995, pp. 162) echoes the idea of a trust-net. He highlights the importance of "stars" and informal networks to the process of achieving flexible and masterful organizational performance:

> A ... sophisticated view of informal networks shows that there are at least three varieties: communications webs - who talks to whom; expertise networks, based on which people are turned to for advice; and trust networks. [T]here is virtually no relationship between being an expert and being seen as someone people can trust with their secrets ... [t]he stars of an organization are often those who have thick connections on all networks. (Goleman, 1995)

Barriers to trust formation

As noted above, a person can make a trusting ascription about someone else, unless something prevents it. Mitchell (1990) found that if B mistrusts A, then B is likely to communicate that mistrust to A, and A is likely to fulfill B's expectations and become untrustworthy. Some people will develop mistrust in a particular other (or low trust capacity in general) as a result of single trauma or a long term environmental condition such as repeated disappointment with someone else (Woititz, 1979 and Black, 1985; in Mitchell, 1990) or from distant, inconsistent and abusive parents (Eigler, 1985 and Viscott, 1977 in Mitchell, 1990). This latter point agrees with Goleman's research, but this time on the origins of *empathy*: neglect seems to lead to a dulling of the empathic response after 30 months, while abuse seems to fertilize a super sharp sense of empathy (hyper-alertness to danger). Other barriers to trust formation include a history of poorly placed trust, distrust of self generalized to others, a need for control (rigidity, which agrees with the circumplex model of distrust relating to dominance) and doubt about ones own ability to survive disappointment (Mitchell, 1990).

APPENDIX B

Survey Questionnaire

This appendix contains the cover letter, the survey questionnaire, the additional two-item qualifying survey (sent with the survey to members of the survey frame who had less than four months tenure with the company), the follow up letter and the thank you letter.

To protect author's intellectual property, all of the items from the BEES and most of the items from the ITS, WKOPAY, PANAS and RD-16 are excluded. PANAS and RD-16 are published elsewhere. CR-4 is presented in full.

The survey questionnaire form includes the following:

Items 1-30:	BEES (empathy)
Items 31-55:	ITS (trust)
Items 56-105:	WKOPAY (creativity)
Items 106-119:	PANAS (positive affect)
Items 120-135:	RD-16 (socially desirable responding)
Items 136-139:	CR-4 (communication)
Items a-f:	demographics.

Survey of Beliefs and Attitudes

Introduction

Dear Respondent: July 15, 1996

Your participation in the enclosed survey can help new product development teams to understand the processes of innovation. Obviously, the development of new products relies on technical knowledge. But the members of development teams must interact successfully to make a smooth transition of products from the drawing board to the marketplace. This survey collects information about individual beliefs and attitudes. The tabulated results will provide researchers with valuable insights into the process of innovation in the medical device industry.

As a professional in the medical device arena, I am asking you to take about 20 minutes to respond to the enclosed reseach questionnaire regarding beliefs and attitudes in the workplace.

Please complete the questionnaire at your earliest opportunity (you may want to fill it out at home) and then return the survey, sealed, in the enclosed envelope.

Your participation is greatly appreciated! Only a small sample of employees will receive the questionnaire, so your participation is important to the study .

The answers you provide are strictly confidential and special precautions have been established to protect the confidentiality of your responses. Your responses, together with others, will be combined and used for statistical summaries only. The questionnaire is anonymous (you should NOT indicate any identifying information), and your survey form will be destroyed once your responses have been tallied.

While this survey was delivered to you through work, completing the survey is not a part of your responsibilities as an employee. This is a University/Industry-related activity, your participation is voluntary, and you may refuse to answer any question. There will be no penalty if you choose not to participate. However, if you choose to take part, your participation will be a valuable contribution to basic research .

If you have questions about the survey, please contact me, or leave a message at (510) 795-8755. You may also contact me by electronic mail at TJSiacotos@aol.com.

Thank you in advance for your cooperation and assistance!

Sincerely,

Thomas J. Siacotos
Dept. of Industrial and Manufacturing Engineering
Oregon State University

➤ ***Please use the following scale to indicate the degree of your agreement or disagreement with each of the statements below.***
Try to describe yourself accurately and generally (that is, the way you are actually in most situations -- not the way you would hope to be).

	Very Strongly Agree	Strongly Agree	Moderately Agree	Slightly Agree	Neither Agree or Disagree	Slightly Disagree	Moderately Disagree	Strongly Disagree	Very Strongly Disagree
1	❑	❑	❑	❑	❑	❑	❑	❑	❑
2	❑	❑	❑	❑	❑	❑	❑	❑	❑
3	❑	❑	❑	❑	❑	❑	❑	❑	❑
4	❑	❑	❑	❑	❑	❑	❑	❑	❑
5	❑	❑	❑	❑	❑	❑	❑	❑	❑
6	❑	❑	❑	❑	❑	❑	❑	❑	❑
7	❑	❑	❑	❑	❑	❑	❑	❑	❑
8	❑	❑	❑	❑	❑	❑	❑	❑	❑
9	❑	❑	❑	❑	❑	❑	❑	❑	❑
10	❑	❑	❑	❑	❑	❑	❑	❑	❑
11	❑	❑	❑	❑	❑	❑	❑	❑	❑
12	❑	❑	❑	❑	❑	❑	❑	❑	❑
13	❑	❑	❑	❑	❑	❑	❑	❑	❑
14	❑	❑	❑	❑	❑	❑	❑	❑	❑
15	❑	❑	❑	❑	❑	❑	❑	❑	❑

	Very Strongly Agree	Strongly Agree	Moderately Agree	Slightly Agree	Neither Agree or Disagree	Slightly Disagree	Moderately Disagree	Strongly Disagree	Very Strongly Disagree
16	❑	❑	❑	❑	❑	❑	❑	❑	❑
17	❑	❑	❑	❑	❑	❑	❑	❑	❑
18	❑	❑	❑	❑	❑	❑	❑	❑	❑
19	❑	❑	❑	❑	❑	❑	❑	❑	❑
20	❑	❑	❑	❑	❑	❑	❑	❑	❑
21	❑	❑	❑	❑	❑	❑	❑	❑	❑
22	❑	❑	❑	❑	❑	❑	❑	❑	❑
23	❑	❑	❑	❑	❑	❑	❑	❑	❑
24	❑	❑	❑	❑	❑	❑	❑	❑	❑
25	❑	❑	❑	❑	❑	❑	❑	❑	❑
26	❑	❑	❑	❑	❑	❑	❑	❑	❑
27	❑	❑	❑	❑	❑	❑	❑	❑	❑
28	❑	❑	❑	❑	❑	❑	❑	❑	❑
29	❑	❑	❑	❑	❑	❑	❑	❑	❑
30	❑	❑	❑	❑	❑	❑	❑	❑	❑

➤ ***Please read each item and indicate the extent to which you agree or disagree.***

		Strongly Agree	Mildly Agree	Agree and Disagree Equally	Mildly Disagree	Strongly Disagree
31	Hypocrisy is on the increase in our society.	❑	❑	❑	❑	❑
32	In dealing with strangers one is better off to be cautious until they have provided evidence that they are trustworthy.	❑	❑	❑	❑	❑
33		❑	❑	❑	❑	❑
34		❑	❑	❑	❑	❑
35		❑	❑	❑	❑	❑
36		❑	❑	❑	❑	❑
37		❑	❑	❑	❑	❑
38		❑	❑	❑	❑	❑
39		❑	❑	❑	❑	❑
40		❑	❑	❑	❑	❑
41		❑	❑	❑	❑	❑
42		❑	❑	❑	❑	❑
43		❑	❑	❑	❑	❑
44		❑	❑	❑	❑	❑
45		❑	❑	❑	❑	❑
46		❑	❑	❑	❑	❑
47	In these competitive times one has to be alert or someone is likely to take advantage of you.	❑	❑	❑	❑	❑

		Strongly Agree	Mildly Agree	Agree and Disagree Equally	Mildly Disagree	Strongly Disagree
48	Many major national sport contests are fixed in one way or another.	❑	❑	❑	❑	❑
49		❑	❑	❑	❑	❑
50		❑	❑	❑	❑	❑
51		❑	❑	❑	❑	❑
52		❑	❑	❑	❑	❑
53		❑	❑	❑	❑	❑
54		❑	❑	❑	❑	❑
55		❑	❑	❑	❑	❑

➢ *Below is a list of characteristics frequently used in talking about people. Indicate, by placing a check (√) beside a or b, the one term of each pair that best describes you. Remember, even if neither term describes you exactly, select the one term of each pair which is nearest to being a description of yourself.*

56	❑	a. Likes to work alone	69	❑	a. Attempts difficult tasks
	❑	b. Prefers to work in a group		❑	b. Desires to excel
57	❑	a. Industrious	70	❑	
	❑	b. Neat and orderly		❑	
58	❑		71	❑	
	❑			❑	
59	❑		72	❑	
	❑			❑	
60	❑		73	❑	
	❑			❑	
61	❑		74	❑	
	❑			❑	
62	❑		75	❑	
	❑			❑	
63	❑		76	❑	
	❑			❑	
64	❑		77	❑	
	❑			❑	
65	❑		78	❑	
	❑			❑	
66	❑		79	❑	
	❑			❑	
67	❑		80	❑	
	❑			❑	
68	❑	a. Curious	81	❑	a. Intuitive
	❑	b. Energetic		❑	b. Thorough

82	❑	a. Never bored	94	❑	a. Self-sufficient
	❑	b. Refined		❑	b. Curious
83	❑		95	❑	
	❑			❑	
84	❑		96	❑	
	❑			❑	
85	❑		97	❑	
	❑			❑	
86	❑		98	❑	
	❑			❑	
87	❑		99	❑	
	❑			❑	
88	❑		100	❑	
	❑			❑	
89	❑		101	❑	
	❑			❑	
90	❑		102	❑	
	❑			❑	
91	❑		103	❑	
	❑			❑	
92	❑		104	❑	
	❑			❑	
93	❑		105	❑	
	❑			❑	

➤ *This scale consists of a number of words that describe different feelings and emotions.*
Read each item and then mark the appropriate answer in the space provided.
Indicate to what extent you have felt this way during the past few months.
Use the following scale to record your answers.

		very slightly or not at all	a little	moderately	quite a bit	extremely
106	interested	❑	❑	❑	❑	❑
107	distressed	❑	❑	❑	❑	❑
108	excited	❑	❑	❑	❑	❑
109		❑	❑	❑	❑	❑
110		❑	❑	❑	❑	❑
111		❑	❑	❑	❑	❑
112		❑	❑	❑	❑	❑
113		❑	❑	❑	❑	❑
114		❑	❑	❑	❑	❑
115		❑	❑	❑	❑	❑
116		❑	❑	❑	❑	❑
117		❑	❑	❑	❑	❑
118		❑	❑	❑	❑	❑
119		❑	❑	❑	❑	❑

➤ *Please read each item and indicate "disagree" or "agree".*

		Agree	Disagree
120	It is difficult to think clearly about right and wrong these days.	❑	❑
121	The future looks very bleak.	❑	❑
122	People will be honest with you as long as you are honest with them.	❑	❑
123		❑	❑
124		❑	❑
125		❑	❑
126		❑	❑
127		❑	❑
128		❑	❑
129		❑	❑
130		❑	❑
131		❑	❑
132		❑	❑
133		❑	❑
134		❑	❑
135		❑	❑

➤ ***Please read each item and indicate the extent to which you agree or disagree.***

		Strongly Agree	Agree	Mildly Agree	Agree and Disagree Equally	Mildly Disagree	Disagree	Strongly Disagree
136	I usually find it hard to get my ideas across to others on my team.	❑	❑	❑	❑	❑	❑	❑
137	Hallway conversations are an important part of team interaction.	❑	❑	❑	❑	❑	❑	❑
138	Free wheeling conversations are a frustrating experience.	❑	❑	❑	❑	❑	❑	❑
139	People seem to feel comfortable using me as a "sounding board".	❑	❑	❑	❑	❑	❑	❑

➤ ***Please provide the following demographic information so that we can verify we have a valid sample.***

---

a. My age, in whole years, as of your last birthday. _____ Decline to State or N/A ❑

b. My gender. Male ❑ Female ❑ Decline to State or N/A ❑

c. My marital status. Single ❑ Married ❑ Divorced ❑ Widowed ❑ Other ❑ Decline to State or N/A ❑

d. My level of formal education, as of today's date. High School ❑ Some College ❑ BS ❑ Master's ❑ Ph. D. ❑ Post Graduate ❑ Decline to State or N/A ❑

f. My tenure* with this company. (Whole years). _____ Decline to State or N/A ❑

*Tenure with the company means the amount of time since you first became involved with the company. For example, if you worked as a consultant (to this company) for 15 months, and then as an employee for 12 months, your tenure would be 15 + 12 = 27 months (you would mark 2 years).

END OF SURVEY

Reminder: All items are voluntary, and you may omit any item at your discretion.

Reminder: This survey is anonymous. The information you have provided will be kept confidential.

Thank you very much for your help and participation!

Survey of Beliefs and Attitudes

Dear Respondent: July 15, 1996

This survey is intended for employees who have sufficient experience working on task teams in the medical device industry. Since you were hired at TTI recently, please answer the following additional questions. Please include your answers with your returned survey.

Thank you!

Sincerely,
Redacted for privacy

Thomas J. Siacotos
Dept. of Industrial and Manufacturing Engineering
Oregon State University

••••••••••••••••••••••••••••••••

Additional Questions
(Circle one)

1) Does you position normally involve working on task teams or project teams?

YES NO

2) Have you worked in the medical device industry for more than 6 months during the last 5 years?

YES NO

Survey of Beliefs and Attitudes

Dear Respondent: July 19, 1996

You may have recently received a Survey of Beliefs and Attitudes as part of a University study. Many of you will have been fortunate enough to have found the time to respond. If so, then thank you very much! Your participation is greatly appreciated !

If you have not yet been able to complete and return the questionnaire, then I'd like to encourage you to do so at your earliest opportunity! The results will provide researchers with valuable insights into the process of innovation in the medical device industry.

After completing the survey, please seal it in the accompanying pre- addressed envelope and return it through inter-office mail.

Once again - thank you very much!

Sincerely,
Redacted for privacy

Thomas J. Siacotos
Dept. of Industrial and Manufacturing Engineering
Oregon State University

Survey of Beliefs and Attitudes

Thank You!

Dear Respondent: July 26, 1996

I want to take this opportunity to thank all of you who particiapted in the Survey of Beliefs and Attitudes recently conducted at Target Therapeutics. The survey forms have been collected, and soon the responses will be tallied.

As stated before, the answers you provided are strictly confidential, and all responses will be combined and used for statistical summaries only. The survey forms themselves will be destroyed once the data has been tallied. If you have any questions about the survey, please contact me, or leave a message at (510) 795-8755.

Once again, thank you very much for participating in this study !

Redacted for privacy

Thomas J. Siacotos
Dept. of Industrial and Manufacturing Engineering
Oregon State University

APPENDIX C

Scores of the Survey Respondents

This appendix shows demographics and scores for each respondent (n=43). SDR means Socially Desirable Responding. Boxed items show scores from incomplete responses; in two cases, the scores could not be used, and are blank. See Exhibit C1.

Exhibit C1: Table of Raw Scores

Subject	Gender	Age	Marital Status	Education Level	Tenure	Trust	Communi-cation	Creativity	Empathy	Positive Affect	SDR
1	m	27	s	3	1	85	18	20	-3	39	13
2	m	38	m	4	2	77	12	36	30	39	15
3	f	omit	m	2	7	85	17	23	66		10
4	m	32	m	3	8	93	8	34	18	35	13
5	f	36	m	3	0	73	17	19	51	35	14
6	f	39	m	4	2	54	13	25	50	40	15
7	f	28	m	2	5	84	10	23	55	35	13
8	f	28	s	3	4	94	11	25	59	32	13
9	m	37	m	3	3	80	10	25	9	40	16
10	f	32	s	4	2	97	11	28	83	44	12
11	f	38	d	4	4	79	13	36	53	43	13
12	m	32	m	4	1	84	12	23	0	37	15
13	m	36	s	2	9	96	12	25	33	36	13
14	f	36	m	3	1	71	11	19	59	41	16
15	f	39	m	4	dts	88	10	33	60	43	16
16	dts	dts	dts	dts	dts	74	12	28	61	38	15
17	m	26	m	4	2	77	10	19	72	44	15
18	dts	dts	dts	dts	dts	78	16	32	7	27	12
19	m	54	m	3	2	76	10	27	66	35	14
20	m	dts	m	2	dts	87	13	19	37	34	12
21	m	40	m	4	5	74	8	35	46	42	16
22	f	dts	m	3	3	85	10	29	62	30	13
23	m	dts	s	3	dts	93	11	28	10	31	14
24	f	36	m	4	0	92	9	32	42	36	14
25	m	26	s	3	5	106	10	30	25	31	12
26	m	24	s	3	3	72	6	27	31	32	15
27	m	dts	s	3	dts	89	15	23	40	37	16
28	m	32	m	3	0	101	12	22	3	43	16
29	m	41	m	4	0	76	15	32	12	45	15
30	m	dts	m	3	dts	75	8	33	49	38	13
31	m	40	d	3	7	77	18	23	33	34	14
32	m	46	m	2	4	88	15	17	37	40	12
33	f	38	m	3	2	79	13	26	59	29	16
34	m	39	d	4	1	82	7	33	37	39	16
35	dts	dts	dts	dts	8	69	18	26	60	39	14
36	f	26	m	3	2	94	11	23	12	28	11
37	f	34	m	6	dts	78	14	28	84	39	16
38	f	31	m	2	4	103	10	30	53	39	10
39	m	49	m	2	4	58	11	29	25	31	13
40	f	37	m	2	3	80	10		62	24	14
41	f	39	s	3	1	72	10	40	76	36	13
42	m	dts	d	3	0	90	12	22	54	50	15
43	m	28	s	3	1	84	8	27	44	41	12

APPENDIX D

A Discussion of Scale Reliability and Validity

To be useful, the results of research must be believed by others. However, others will not believe the results if the evidence is unbelievable, and the evidence will be unbelievable if it relies on measurements (especially measurements of attitudes, beliefs and emotions) from instruments which are unreliable or invalid. That is, unless a supporting measurement instrument has been shown reliable and valid, the results of the research will not be believable, and so will not be useful.

An instrument[33] is reliable if it has stability, equivalence and homogeneity. An instrument is valid if it has predictive validity, concurrent validity, content validity and construct validity.

Reliability

STABILITY

An instrument has stability if it gives the same measurement (provided the subject does not change) from time to time. For example, if Achilles uses a yardstick to measure the Tortoise's shell one week before Christmas Day, 1960 finds it to be 28", and then measures it again on November 18th of the following year, still 28", and meanwhile the Tortoise has not actually changed length, then Achilles can say the yardstick has stability. Another name for stability is test/retest reliability.

Related to stability, but somewhat different, is the ability of the survey to measure the construct in question, versus measuring other things like educational level. An instrument has this kind of reliability if it provides similar results when it is given to different kinds of people or to people who live in different places, have different income levels or have different educational levels.

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33 For purposes of this Appendix, "instrument" refers to a survey research instrument used in the fields of sociology and psychology primarily for the evaluation of personality states and traits.

EQUIVALENCE

An instrument has equivalence if two forms of the same instrument (when given to the same subject) give the same score. For example, an instrument has equivalence if the same scores are derived regardless of the order of the items, or when the instrument is deliverd both on paper or by a computerized survey method.

HOMOGENEITY

If a researcher used an instrument with one item (question), then a misunderstanding or small misjudgement on the part of the respondent could throw off the measurement disproportionately. To avoid this, researchers sometimes rely on averaging the responses to several or many items to obtain a score. This works if no subset of the items tends to be disproportionately sensitive to the attitude or behavior of interest. An instrument has homogeneity if subsets of the survey items in different combinations tend to provide about the same level of influence on the final score. Hence, if Achilles gives one half of the survey to the Tortoise in the morning, he should obtain roughly the same score as when, in the afternoon, he gives the Tortoise the other half of the survey. Homogeneity is also called split-half reliability.

Validity

PREDICTIVE VALIDITY

An instrument has predictive validity if the measurement is indicative of something else, for example some ability, tendency or behavior. Not all researchers need this kind of validity, but some do. If Achilles asks the Tortoise if he has can breath underwater, the answer may have some predictive validity with respect to Tortoise's ability to dive to great depths, but probably is not a good predictor of Tortoise's desire to swim.

CONCURRENT VALIDITY

An instrument has concurrent validity if it gives the same measurement as another established instrument designed to measure the same thing. Say Achilles uses a new software program to measure the Tortoise's typing speed, then uses an old-fashioned manual scoring method (that lots of people accept) soon afterwards. If the scores are the same (or many such score pairs show a statistical correlation), then Achilles can say the software method has concurrent validity, at least relative to the particular old-fashioned method used.

CONTENT VALIDITY

An instrument has content validity if "...its items or questions accurately represent the characteristics or attitudes that they are intended to measure...usually established by asking experts whether the items are representative samples of the attitudes and traits you want to survey." Emphasis added. (Fink & Kosecoff, 1985) For example, suppose Tortoise wanted to know about Achilles attitude toward inhabitants of a nearby beach community. A survey which contained questions about the Crab, seaweed and steelhead trout might have content validity. However, if the survey also contained items asking Achilles opinions regarding surfing, suntans and the Beach Boys, then the survey might be considered content invalid.

CONSTRUCT VALIDITY

Psychologists try to describe various aspects of human experience by making constructs. For example, the word "empathy" is a label that psychologists attach to the construct of empathy, which is itself the thing psychologists think about when studying and discussing the phenomenon a person feeling the same feelings as another in response to that other. The thing to keep in mind here is that the label, the construct and the phenomenon are different things.

An instrument has construct validity if it measures a psychological construct. Suppose Tortoise wanted to know if Achilles had a tendency to lie. The tendency to lie in general is a psychological construct. If Tortoise asks Achilles questions designed to illicit reports of past lying, and reports of past lying are known to correlate with the phenomenon of actual tendency to lie (usually as reported by one or more expert judges), then Tortoise can claim the survey has good construct validity.

Response Bias and Response Sets

In addition to survey reliability and validity, as researchers we are also concerned about Response Bias and Response Sets.

Note that in the previous example, during the survey, Achilles must tell the truth - otherwise, the survey results, especially with respect to content validity, are suspect. The tendency to lie during the survey process (as opposed to lying in the general course of events) is one example of a response bias. Other examples include the tendency to respond positively, respond negatively, respond neutrally and respond in socially desirable ways. None of these tendencies (which are properties of the survey subject) are generally accounted for in establishing the reliability and validity of the survey instrument itself. However, response bias is often controlled for by embedding in the base survey a subset of special survey items designed to detect the bias in question for the purpose of eliminating response sets.

APPENDIX E

Data Analysis Details

The following pages contain Exhibits E1 through E15 containing the scatter gram and the correlation analysis of each pair of variables. These results are summarized in Exhibits 8 and 9. Note that for each exhibit here, data from the first 10 respondents is shown, while data from all eligible responses was used to compute the coefficient of correlation and to create the scatter gram.

A t-test on ages (two-tailed assuming equal variances, $n_{sample} = 33$, $n_{frame} = 112$ and H_o: $\mu_{sample} = \mu_{frame}$) showed $P(T<=t_{critical}) = 0.98$ at $\alpha = 0.05$. Additionally, mean, variance, skew and kurtosis are similar. The ages of the respondents appear randomly selected from the distribution of ages of the frame, so the age of the respondent does not appear to be a factor in whether or not they responded. There appears to be no age-based sampling bias.

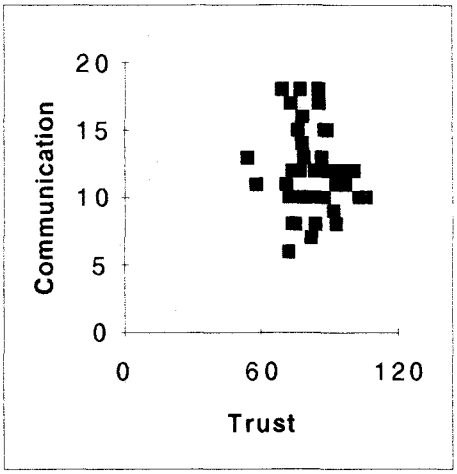
Also, given x = number of females in the sample = 17, $n_{sample} = 40$ (3 declined to identify gender), $n_{frame\ total} = 112$, $n_{frame\ females} = 38$, then $p = 38/112 = .339$, $q = 1-p = .661$, $\mu = np = 43(.339) = 14.58$, $\sigma = \text{root}(npq) = 3.10$. Note that $z = (17 - 14.58)/3.10 = 0.781$, but since $z < z_{\alpha/2} = z_{.05} = 1.645$, it appears that x = 17 is not a rare event, so we cannot conclude gender had a significant effect on whether or not the subjects responded. There appears to be no gender-based sampling bias.

The sample appears valid because it seems to be drawn randomly from the sample frame.

Exhibit E1

Trust and Communication

Subject	Trust	Communication
1	85	18
2	77	12
3	85	17
4	93	8
5	73	17
6	54	13
7	84	10
8	94	11
9	80	10
10	97	11
more	more	more



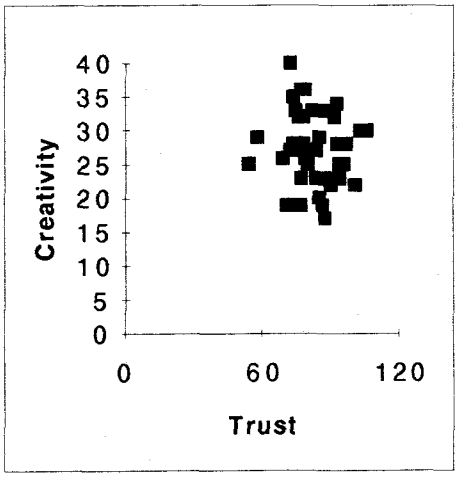
α =	.050	r-crit =	.257	
n =	43	r =	-.13	**NOT Significant**

Trust and communication are not correlated.

Exhibit E2

Trust and Creativity

Subject	Trust	Creativity
1	85	20
2	77	36
3	85	23
4	93	34
5	73	19
6	54	25
7	84	23
8	94	25
9	80	25
10	97	28
more	more	more



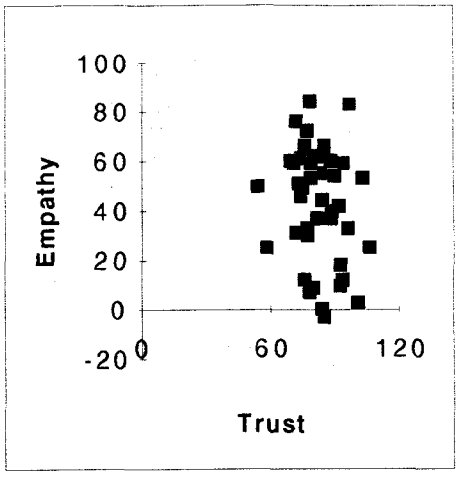
α =	.050	r-crit =	.257	
n =	43	r =	-.08	**NOT Significant**

Trust and creativity are not correlated.

Exhibit E3

Trust and Empathy

Subject	Trust	Empathy
1	85	-3
2	77	30
3	85	66
4	93	18
5	73	51
6	54	50
7	84	55
8	94	59
9	80	9
10	97	83
more	more	more



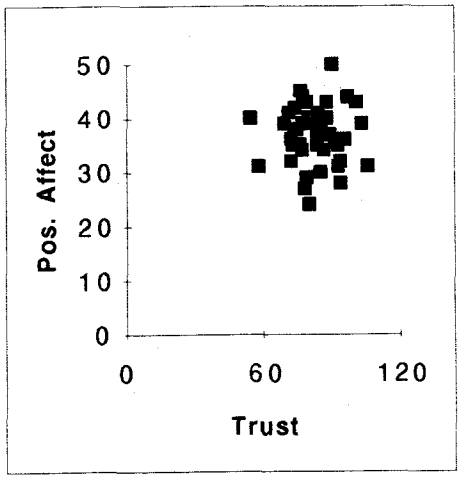
α =	.050	r-crit =	.257	
n =	43	r =	-.19	**NOT Significant**

Trust and empathy are not correlated.

Exhibit E4

Trust and Positive Affect

Subject	Trust	Pos. Affect
1	85	39
2	77	39
3	85	
4	93	35
5	73	35
6	54	40
7	84	35
8	94	32
9	80	40
10	97	44
more	more	more



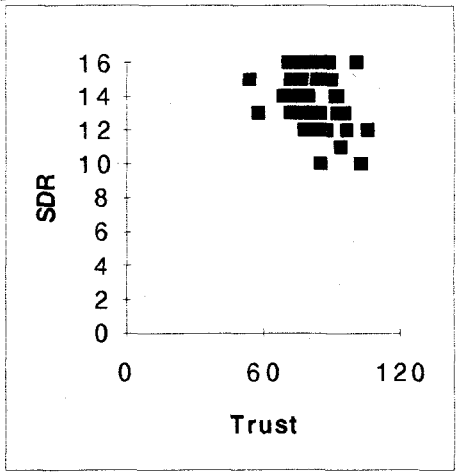
α =	.050	r-crit =	.257	
n =	43	r =	-.01	**NOT Significant**

Trust and positive affect are not correlated.

Exhibit E5

Trust and Socially Desirable Responding

Subject	Trust	SDR
1	85	13
2	77	14
3	85	14
4	93	12
5	73	15
6	54	16
7	84	16
8	94	15
9	80	13
10	97	14
more	more	more



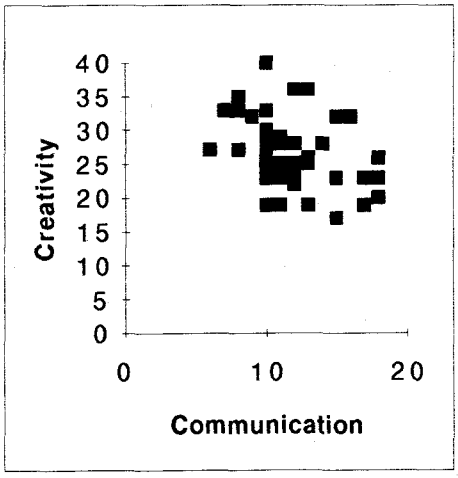
α =	.050	r-crit =	.257	
n =	43	r =	-.35	**Significant**

Trust and SDR appear somewhat negatively correlated.

Exhibit E6

Communication and Creativity

Subject	Communication	Creativity
1	18	20
2	12	36
3	17	23
4	8	34
5	17	19
6	13	25
7	10	23
8	11	25
9	10	25
10	11	28
more	more	more



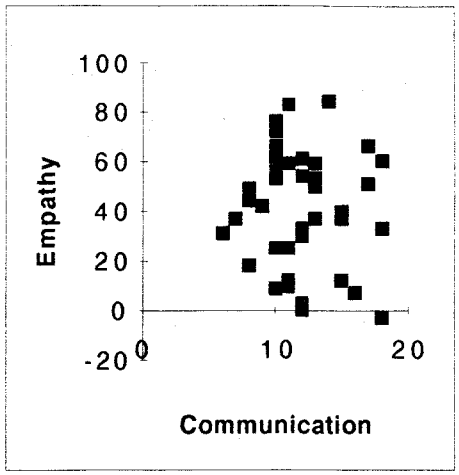
α =	.050	r-crit =	.257	
n =	43	r =	-.41	**Significant**

Communication and creativity appear somewhat negatively correlated.

Exhibit E7

Communication and Empathy

Subject	Communication	Empathy
1	18	-3
2	12	30
3	17	66
4	8	18
5	17	51
6	13	50
7	10	55
8	11	59
9	10	9
10	11	83
more	more	more



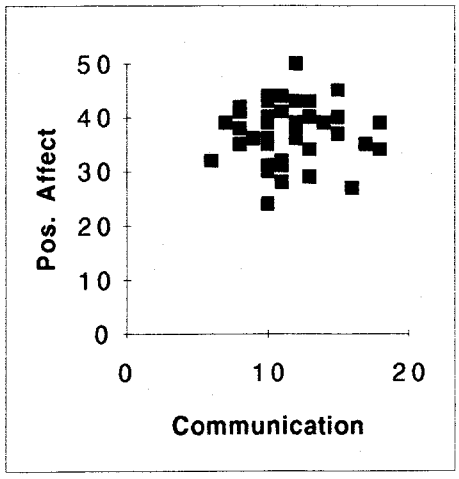
α =	.050	r-crit =	.257	
n =	43	r =	-.10	**NOT Significant**

Communication and empathy are not correlated.

Exhibit E8

Communication and Positive Affect

Subject	Communication	Pos. Affect
1	18	39
2	12	39
3	17	
4	8	35
5	17	35
6	13	40
7	10	35
8	11	32
9	10	40
10	11	44
more	more	more



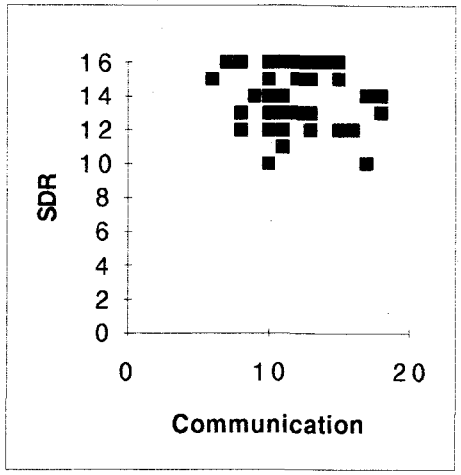
α =	.050	r-crit =	.257	
n =	43	r =	.03	**NOT Significant**

Communication and positive affect are not correlated.

Exhibit E9

Communication and Socially Desirable Responding

Subject	Communication	SDR
1	18	13
2	12	14
3	17	14
4	8	12
5	17	15
6	13	16
7	10	16
8	11	15
9	10	13
10	11	14
more	more	more



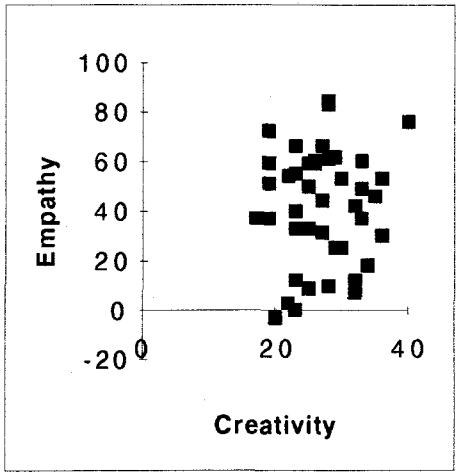
α =	.050	r-crit =	.257	
n =	43	r =	-.11	**NOT Significant**

Communication and SDR are not correlated.

Exhibit E10

Creativity and Empathy

Subject	Creativity	Empathy
1	20	-3
2	36	30
3	23	66
4	34	18
5	19	51
6	25	50
7	23	55
8	25	59
9	25	9
10	28	83
more	more	more



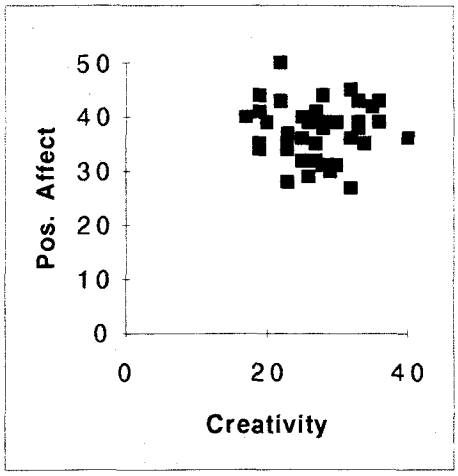
α =	.050	r-crit =	.257	
n =	43	r =	.08	**NOT Significant**

Creativity and empathy are not correlated.

Exhibit E11

Creativity and Positive Affect

Subject	Creativity	Pos. Affect
1	20	39
2	36	39
3	23	
4	34	35
5	19	35
6	25	40
7	23	35
8	25	32
9	25	40
10	28	44
more	more	more



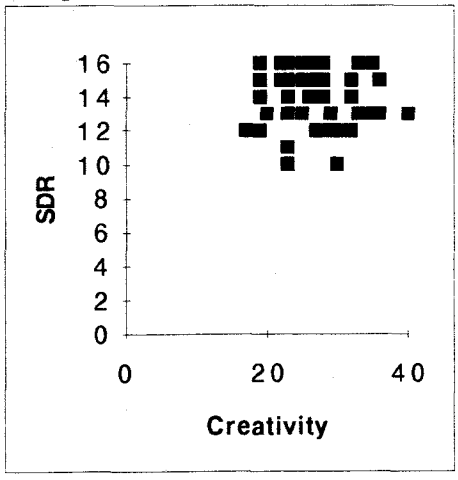
α =	.050	r-crit =	.257	
n =	43	*r* =	-.03	**NOT Significant**

Creativity and positive affect are not correlated.

Exhibit E12

Creativity and Socially Desirable Responding

Subject	Creativity	SDR
1	20	13
2	36	14
3	23	14
4	34	12
5	19	15
6	25	16
7	23	16
8	25	15
9	25	13
10	28	14
more	more	more



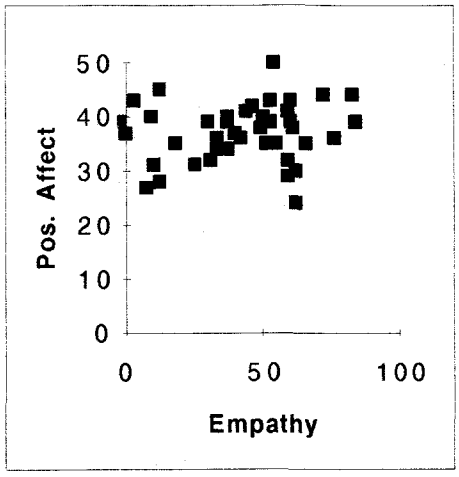
α =	.050	r-crit =	.257	
n =	43	r =	.02	**NOT Significant**

Creativity and SDR are not correlated.

Exhibit E13

Empathy and Positive Affect

Subject	Empathy	Pos. Affect
1	-3	39
2	30	39
3	66	
4	18	35
5	51	35
6	50	40
7	55	35
8	59	32
9	9	40
10	83	44
more	more	more



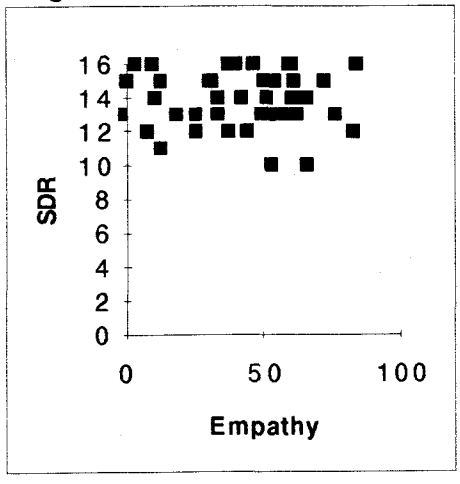
α =	.050	r-crit =	.257	
n =	43	r =	.16	**NOT Significant**

Empathy and positive affect are not correlated.

Exhibit E14

Empathy and Socially Desirable Responding

Subject	Empathy	SDR
1	-3	13
2	30	14
3	66	14
4	18	12
5	51	15
6	50	16
7	55	16
8	59	15
9	9	13
10	83	14
more	more	more



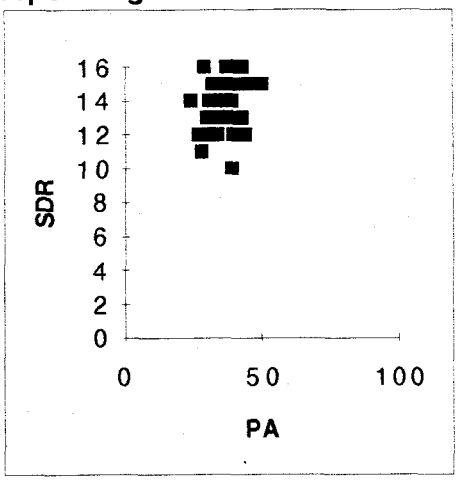
α =	.050	r-crit =	.257	
n =	43	r =	.00	**NOT Significant**

Empathy and SDR are not correlated.

Exhibit E15

Positive Affect and Socially Desirable Responding

Subject	PA	SDR
1	39	13
2	39	14
3		14
4	35	12
5	35	15
6	40	16
7	35	16
8	32	15
9	40	13
10	44	14
more	more	more



α =	.050	r-crit =	.257	
n =	43	r =	.32	**Significant**

PA and SDR appear somewhat positively correlated.

Exhibit E16: Results of t-Tests

Sample: Self Reported Age	Frame: Database Reported Age		
24	24	34	42
26	25	34	42
26	25	34	42
26	25	34	42
27	26	34	42
28	26	35	43
28	26	35	43
28	26	35	44
31	27	35	44
32	27	35	44
32	27	35	46
32	27	35	46
32	27	36	49
34	28	36	50
36	28	36	52
36	28	36	54
36	28	36	56
36	28	36	
37	28	36	
37	29	36	
38	29	37	
38	29	37	
38	30	37	
39	30	37	
39	30	37	
39	30	37	
39	30	37	
40	30	38	
40	31	38	
41	31	38	
46	31	38	
49	31	38	
54	31	38	
	32	38	
	32	38	
	32	39	
	32	39	
	32	39	
	33	39	
	33	40	
	33	41	
	34	41	

t-Test:
Two-Sample Assuming Equal Variances

	Var 1	*Var 2*
Mean	35.2727	35.2233
Variance	46.642	43.783
Observations	33	103
Pooled Variance	44.4657	
Hypothesized Mean Shift	0	
df	134	
t	0.03706	
P(T<=t) one-tail	0.48525	
t Critical one-tail	1.6563	
P(T<=t) two-tail	0.9705	
t Critical two-tail	1.97782	
Kurtosis	0.63038	0.54665
Skew	0.55382	0.6738

APPENDIX F

Permissions and Correspondence

This appendix includes correspondance between the researcher and the authors of each of the five measures (including permissions to use ITS, BEES, WKOPAY, PANAS and RD-16) and permission to proceed with the survey, obtained through the University's IRB process. Refer to Exhibits F1 through F7.

UNIVERSITY OF

CONNECTICUT

THE COLLEGE OF LIBERAL ARTS AND SCIENCES
Department of Psychology

March 1, 1996

Tom Siacotos
36078 Bayonne Place
Newark, CA 94538

Dear Mr. Siacotos:

I am enclosing a keyed copy of the Interpersonal Trust Scale. Permission to use the scale in your research would depend on whether or not you are trained in the use and interpretation of personality tests or are supervised by, or consult with, a person who is so trained.

Very truly yours,

Redacted for privacy

Julian B. Rotter
Professor of Psychology

An Equal Opportunity Employer

406 Babbidge Road, U-20, Storrs, Connecticut 06269-1020 (860) 486-3515 Fax: (860) 486-2760

Dr. Julian Rotter
University of Connecticut
Department of Psychology
406 Babbidge Road, U-20, Room 107
Storrs, CT 06269-1020

4/3/96

Thomas Siacotos, Graduate Student
Department of Industrial and Manufacturing Engineering
Oregon State University (OSU)
36078 Bayonne Place
Newark, California 94560
(510) 795-8755 (Home), (510) 440-7855 (Work), TJSiacotos@aol.com (e-mail)

Dear Dr. Rotter:

Thank you very much for your response (March 1) to my request for permission to use the Interpersonal Trust Scale. Your response indicated permission to use the scale "...depends on whether or not [I am] trained in the use and interpretation of personality tests or are supervised by, or consult with, a person who is so trained."

I have considered your words carefully and conclude your intention is that I use the ITS properly I believe I have the knowledge and resources to support proper use of personality scales.

My training

While my training is in the field of industrial and manufacturing engineering, I have studied the application of personality tests since July, '95, in support of my thesis. The thesis deals with engineering management, and my topic required research in psychology, an area previously unfamiliar to me, except for my course work in Human Factors.

My supervisor

In addition, Dr. Kim Douglas of Oregon State University is my Major Professor, and is supervising my work. She has personal experience using survey research methods as applied to engineering work groups (her dissertation), although not specifically with *personality* tests.

Other resources

I also have at my disposal a number of resources to facilitate the proper collection and interpretation of the survey results: Leone Nidiffer, a personal contact, employed at California State University, Hayward, who designs and implements survey research routinely as part of her employment; Ms. Chun-Ho Kuo, a Graduate Student at OSU who has offered to help with statistical analysis; and The Survey Research Center at OSU. Should the need arise, I may also contact Dr. Lynn Arnaut, an instructor and psychologist, recently of the Department of Psychology at OSU, currently on sabbatical.

Based on your letter, it appears unnecessary to request confirmation of your permission to use the ITS; I believe I have your permission. If you review this letter and decide otherwise, please contact me at your earliest convenience by mail (or electronic mail) at the above address. Thank you again for your help!

Sincerely,

Thomas J. Siacotos

Exhibit F2: Permission to use BEES

Albert Mehrabian, Ph.D.

Dear Thomas Siacotos:

Your are hereby given permission to duplicate and use the Balanced Emotional Empathy test for use with subjects who you will be running in your own experimental studies. Please note you are not allowed to reproduce any items of the scale listed above in any medium for distribution to others (e.g., dissertation, journal article, book, computer program, or another test or test manual). Others in your department or school who may wish to use the scale listed above need to contact me at the address below for permission to use it.

Best wishes,

Redacted for privacy

Albert Mehrabian

April 27, 96

PS. Please call if you have any questions or need help.

Exhibit F3: Permission to use WKOPAY

SCHOLASTIC TESTING SERVICE, INC.

480 MEYER ROAD
BENSENVILLE, ILL. 60106
(708) 766-7150

4320 GREEN ASH DRIVE
EARTH CITY, MISSOURI 63045
(314) 739-3650

Serving the Educational Community Since 1953

SHIP TO 510-795-8755	BILL TO
ATTN: THOMAS J. SIACTOS 36078 BAYONNE PLACE NEWARK, CA 94560	PROFESSOR: KIMBERLY DOUGLAS STUDENT:

PROCESSING	TEST DATE	CODES	CUSTOMER ORDER NO.	ACCOUNT
3/6/96	ASAP		CHARGE	

QUANTITY	MATERIALS/SERVICE	DESCRIPTION	FM	GR
1 PKG	KT CAT#: KT100017	K.T.C.P.I. INVENTORY STARTER SET		
		SHIPPING HANDLING		
		TOTAL AMOUNT DUE:		
	SHIPPING DATE	#CTNS WT VIA		

PACKING SLIP

Subj: Use of the PANAS
Date: Tue, Apr 9, 1996 9:17 AM PST
From: dwatson@blue.weeg.uiowa.edu
X-From: dwatson@blue.weeg.uiowa.edu (watson david)
To: tjsiacotos@aol.com (Thomas Siacotos)

Dear Mr. Siacotos,

I am responding to your recent letters asking for permission to use our PANAS scales in your research. I routinely grant permission to use the scales in research, and I am happy to do so in this case. Please note, however, that the American Psychological Association is the official copyright holder for the scales (because they originally were published in a 1988 article in the Journal of Personality and Social Psychology), so you should be sure to ask their permission as well.

In addition, I was puzzled by two aspects of your request. First, you wondered if the PANAS scales could be converted into a 5-point Likert-type format: Note, however, that this is exactly how the scales normally are administered. In fact, your enclosed format is exactly the format we have used over the past decade! Did you perhaps see an altered version of the scales? Second, the sample form you enclosed included only 5 negative and 5 positive items. The original PANAS consists of 20 items--10 for each scale. Are you planning to use only half the items? If so, this necessarily would affect the reliability and validity of the measures.

Let me know if you would like any more information regarding the scales. Thank you for your interest in our work.

Sincerely,

David Watson
Professor of Psychology

---------- Headers ----------
From dwatson@blue.weeg.uiowa.edu Tue Apr 9 13:17:45 1996
Return-Path: dwatson@blue.weeg.uiowa.edu
Received: from mail-hub2.weeg.uiowa.edu (mail-hub2.weeg.uiowa.edu [128.255.56.22]) by emin25.mail.aol.com (8.6.12/8.6.12) with ESMTP id NAA04836 for <tjsiacotos@aol.com>; Tue, 9 Apr 1996 13:17:44 -0400
Received: from black.weeg.uiowa.edu (root@black.weeg.uiowa.edu [128.255.56.4]) by mail-hub2.weeg.uiowa.edu (8.7.5/8.7.3) with SMTP id MAA08164 for <tjsiacotos@aol.com>; Tue, 9 Apr 1996 12:17:43 -0500
Received: by black.weeg.uiowa.edu (8.6.13/client-1.3) id MAA41280; Tue, 9 Apr 1996 12:15:04 -0500
Date: Tue, 9 Apr 1996 12:15:04 -0500 (CDT)
From: watson david <dwatson@blue.weeg.uiowa.edu>
X-Sender: dwatson@black.weeg.uiowa.edu

To: dwatson@blue.weeg.uiowa.edu
Subj: Re: Use of the PANAS
Dear Dr. Watson,

Thank you for your reply to my request to use the PANAS scales. I accept your permission, and I will seek permission from the official copyright holder, the APA.

I saw the PANAS in

Watson, Clark & Tellegen (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology, 54(6), 1063-1070.

Specifically, I saw the PANAS presented in the Appendix and interpreted it as a format other than a Likert-type scale. Your response tells me what I need to know - that I will obtain valid results using the format I sent to you earlier.

Regarding your second question (proposing to use only half the adjectives): After I received your response, I compared (more carefully this time!) the Appendix to Table 5 (same article, p. 1067). Note my goal is to measure positive affect only. However, I can see I selected the wrong 10 adjectives. I should have selected the adjectives heavily loaded on positive affect: Enthusiastic, Interested, Determined, Excited, Inspired, Alert, Active, Strong, Proud and Attentive.

Now I must rephrase my question. If I use only these 10 adjectives in an attempt to measure positive affect only (and shorten my questionnaire!), will I obtain a valid measure of positive affect? Or is the measurement of PA valid only when all 20 adjectives are presented?

Thank you very much for your advise,

Tom

Subj: Re: Use of the PANAS
Date: Mon, Apr 15, 1996 10:53 AM PST
From: dwatson@blue.weeg.uiowa.edu
X-From: dwatson@blue.weeg.uiowa.edu (watson david)
To: TJSiacotos@aol.com

You certainly don't need to include all 20 terms to achieve a valid assessment of Positive Affect. However, I would suggest including at least a few negative terms, to enhance the variety of the items and to descourage simple response sets.

David Watson

---------- Headers ----------
From dwatson@blue.weeg.uiowa.edu Mon Apr 15 14:53:23 1996
Return-Path: dwatson@blue.weeg.uiowa.edu
Received: from mail-hub1.weeg.uiowa.edu (mail-hub1.weeg.uiowa.edu [128.255.56.24]) by emin24.mail.aol.com (8.6.12/8.6.12) with ESMTP id OAA12109 for <TJSiacotos@aol.com>; Mon 1996 14:53:20 -0400
Received: from black.weeg.uiowa.edu (root@black.weeg.uiowa.edu [128.255.56.4]) by mail-hub1.weeg.uiowa.edu (8.7.5/8.7.3) with SMTP id NAA30250 for <TJSiacotos@aol.com>; M Apr 1996 13:53:19 -0500
Received: by black.weeg.uiowa.edu (8.6.13/client-1.3) id NAA69755; Mon, 15 Apr 1996 13:51:26 -0500
Date: Mon, 15 Apr 1996 13:51:25 -0500 (CDT)
From: watson david <dwatson@blue.weeg.uiowa.edu>
X-Sender: dwatson@black.weeg.uiowa.edu
To: TJSiacotos@aol.com
Subject: Re: Use of the PANAS
In-Reply-To: <960415143308_375876513@emout04.mail.aol.com>
Message-ID: <Pine.A32.3.91.960415134956.97834B-100000@black.weeg.uiowa.edu>
MIME-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII

Subj: Copyright Permission
Date: Tue, Apr 23, 1996 6:05 AM PST
From: kat.apa@email.apa.org
X-From: kat.apa@email.apa.org (Thomas, Karen)
Sender: kat.apa@email.apa.org (Thomas, Karen)
To: tjsiacotos@aol.com

Mr. Siacotos: Your permission request has been directed to my attention. APA grants permission without fee for non-exclusive, one-time use of APA-copyrighted material for research purposes (as outlined in your request). Any other use of the PANAS scales requires additional APA permission. The reproduced material needs to include a full bibliographic citation and the following notice: Copyright 1988 by the American Psychological Association. Reprinted with permission.

Please note that future requests to use APA-copyrighted material will need to be sent to: Karen Thomas, APA Permissions Office, 750 First Street, NE, Washington, DC 20002-4242.

We appreciate your interest in APA-copyrighted material. If I can be of any further assistance, please do not hesitate to contact me at 202-336-5541.

Yours truly,

Karen A. Thomas, APA Rights and Permissions

---------- Headers ----------
From kat.apa@email.apa.org Tue Apr 23 10:05:25 1996
Return-Path: kat.apa@email.apa.org
Received: from email.apa.org ([192.231.215.5]) by emin31.mail.aol.com (8.6.12/8.6.12) with SMTP id KAA09843 for <tjsiacotos@aol.com>; Tue, 23 Apr 1996 10:05:22 -0400
Received: from Connect2 Message Router by email.apa.org via Connect2-SMTP 4.00; Tue, 23 Apr 96 10:06:13 -0400
Message-ID: <D20B807501D7C1AA@email.apa.org>
Date: Tue, 23 Apr 96 10:02:16 -0400
From: "Thomas, Karen" <kat.apa@email.apa.org>
Sender: "Thomas, Karen" <kat.apa@email.apa.org>
Organization: APA
To: tjsiacotos@aol.com
Subject: Copyright Permission
X-mailer: Connect2-SMTP 4.00 MHS to SMTP Gateway

Exhibit F6: Permission to use RD-16

Subj: RD16
Date: Sun, May 26, 1996 5:33 AM PST
From: schuess@indiana.edu
X-From: schuess@indiana.edu (Karl Schuessler)
To: TJSiacotos@aol.com

I am pleased that you are planning to use RD16 in your thesis research. You of course have my permission. Good luck in your survey and I would be pleased to see your results. I am an obsolete sociologist but I still maintain an interest in social measurement and allied subjects. Sincerely Karl Schuessler, Emeritus.

---------- Headers ----------
From schuess@juliet.ucs.indiana.edu Sun May 26 12:33:32 1996
Return-Path: schuess@juliet.ucs.indiana.edu
Received: from roatan.ucs.indiana.edu (roatan.ucs.indiana.edu [129.79.10.65]) by emin01.mail.aol.com (8.6.12/8.6.12) with ESMTP id MAA22731 for <TJSiacotos@aol.com>; Sun, 26 May 1996 12:33:32 -0400
Received: from juliet.ucs.indiana.edu (schuess@juliet.ucs.indiana.edu [129.79.10.43]) by roatan.ucs.indiana.edu (8.7.3/8.7.3/1.10IUPO) with ESMTP id LAA30491 for <TJSiacotos@aol.com>; Sun, 26 May 1996 11:33:44 -0500 (EST)
Received: (from schuess@localhost) by juliet.ucs.indiana.edu (8.7/8.7/regexp($Revision: 1.3 $) id LAA03922; Sun, 26 May 1996 11:33:31 -0500 (EST)
Date: Sun, 26 May 1996 11:33:30 -0500 (EST)
From: Karl Schuessler <schuess@indiana.edu>
X-Sender: schuess@juliet.ucs.indiana.edu
To: TJSiacotos@aol.com
Subject: RD16
Message-ID: <Pine.HPP.3.91.960526112923.3192B-100000@juliet.ucs.indiana.edu>
MIME-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII

Exhibit F7: Permission to proceed with the survey, from OSU's IRB

OFFICE
OF
DEAN OF RESEARCH

OREGON
STATE
UNIVERSITY

312 Administrative Services
Corvallis, Oregon
97331-2140

541-737-0670
FAX: 541-737-3093
INTERNET
nunnm@ccmail.orst.edu

April 12, 1996

Principal Investigator:

The following project has been approved for exemption under the guidelines of Oregon State University's Committee for the Protection of Human Subjects and the U.S. Department of Health and Human Services:

Principal Investigator(s):	Kimberly Douglas
Student's Name (if any):	Thomas J. Siacotos
Department:	Industrial Engineering
Source of Funding:	
Project Title:	Trust, Communication, and Creativity in New Product Development Teams
Comments:	

A copy of this information will be provided to the Committee for the Protection of Human Subjects. If questions arise, you may be contacted further.

Sincerely,

Redacted for privacy

Mary E. Nunn
Sponsored Programs Officer

cc: CPHS Chair

Index